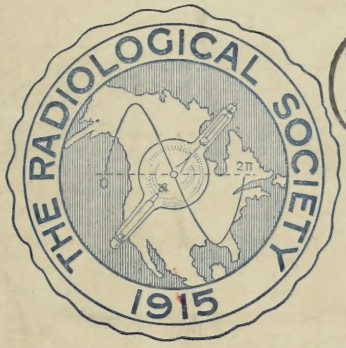
Biological & Medical Serials
RM 695 A75 v.3 no.8
Biological & Medical Serials

Archives of Physical Medicine

THE JOURNAL OF RADIOLOGY

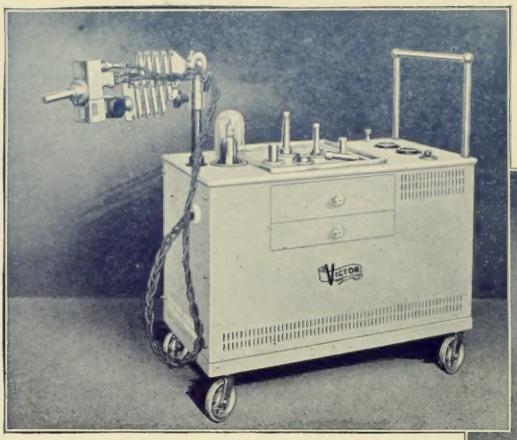
VOL. III AUGUST, 1922 No. 8



LIBRARY
APR 5 1923
UNIVERSITY OF TORONTO

STORAGE

PUBLISHED MONTHLY BY
THE RADIOLOGICAL SOCIETY
OF NORTH AMERICA
AT OMAHA, NEBRASKA



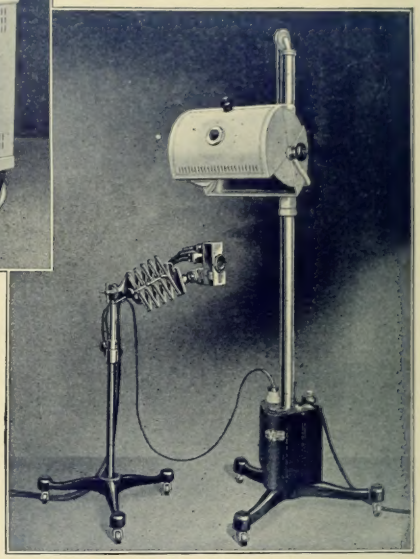
Hospital Unit

Your Actino-Therapy Equipment

is described interestingly and in every detail in Victor Quartz Lamp Bulletin No. 253 just off the press. Your copy, together with several important reprints, will be mailed on request.

This new catalog introduces Victor Ultra-Violet Lamps, the most recent addition to the Victor line of Electro-Medical apparatus. These lamps are the well-known Burdick Models, embodying advanced ideas in electrical and mechanical design and construction.

Actino-Therapy has created a wide interest in the medical sciences, and the increasing demand for equipment is an indication of recognition by the profession of its broad application and effectiveness. In your consideration of equipment, bear in mind that the same research and engineering facilities responsible for Victor X-Ray apparatus are available for maintaining an equally high standard for Victor Ultra-Violet Lamps.



Combination Air-Cooled and Water-Cooled Equipment

Another important factor—*Victor Service*, through our Branch Sales and Service Stations located in the principal cities. This trained field organization assures you permanent satisfaction in a Victor outfit.

WRITE FOR PARTICULARS

VICTOR X-RAY CORPORATION, Jackson Blvd. at Robey St., Chicago

Sales Offices and Service Stations in All Principal Cities

VICTOR

THE JOURNAL OF RADIOLOGY

PUBLISHED BY

The Radiological Society of North America

CONTENTS

Radio-Toxemia—Its Cause and Suggestions for Its Prevention 301
(Emil G. Beck, M. D., F. A. C. S.)

Teamwork Between the Roentgenologist and the Pathologist 308
(H. E. Robertson, M. D.)

Bone Diseases: Non-Suppurating Osteomyelitis (Garre)—Infectious Ossifying Periostitis (Bloodgood) 310
(Joseph Colt Bloodgood, M. D.)

The Value of Imbedding Radium in the Treatment of Carcinoma of the Breast 317
(Russell H. Boggs, M. D.)

An Effect of X-ray on the Germ Cells 320
(James W. Mavor, Ph. D.)

A System of Roentgen Ray Anthropometry (The Skull) 322
(A. J. Pacini, M. D.)

Editorials 332
- Introducing Mr. Public Interest.
- Introducing Dr. Frothingham.
- Introducing Dr. Anonymous.
- Foundations of Science.
- The Future of Radiology.
- American Roentgen Ray Meeting.
- Annual Meeting.

Department of Technique 339

New Equipment 341

Abstracts and Reviews 345

Entered as second class matter at the postoffice at Omaha, Nebraska, under the Act of March 3d, 1879.

Copyright, 1922, The Radiological Publishing Co., Omaha, Nebraska.

The Radiological Society of North America

Officers of the Society

PRESIDENT

ALBERT SOILAND, M. D. ..... *Los Angeles, California*

PRESIDENT-ELECT

RUSSELL D. CARMAN, M. D. ..... *Rochester, Minnesota*

FIRST VICE-PRESIDENT

ROLLIN H. STEVENS, M. D. ..... *Detroit, Michigan*

SECOND VICE-PRESIDENT

LEON T. LEWALD, M. D. ..... *New York City, New York*

THIRD VICE-PRESIDENT

LEO PARISEAU, M. D. ..... *Montreal, Quebec, Canada*

SECRETARY-TREASURER

MANLY J. SANDBORN, M. D. ..... *Appleton, Wisconsin*

EXECUTIVE COMMITTEE

ROBT. J. MAY, M. D. ..... *Cleveland, Ohio*
ARTHUR W. ERSKINE, M. D. ..... *Cedar Rapids, Iowa*
MAXIMILIAN JOHN HUBENY, M. D. ..... *Chicago, Illinois*

Editorial Staff

MANAGING EDITOR

ALBERT F. TYLER, M. D. ..... *511 City National Bank Building, Omaha, Nebraska*

ASSOCIATE EDITOR

EDWARD W. ROWE, M. D. ..... *First National Bank Building, Lincoln, Nebraska*

Collaborators

HERBERT ASSMAN, M. D. ..... *Leipzig*
A. E. BARCLAY, M. D. ..... *Manchester, England*
HENRI BECLERE, M. D. ..... *Paris, France*
FRANK S. BISSELL, M. D. ..... *Minneapolis, Minn.*
RUSSELL D. CARMAN, M. D. ..... *Rochester, Minn.*
L. J. CARTER, M. D. ..... *Brandon, Manitoba, Canada*
LEWIS GREGORY COLE, M. D. ..... *New York City, N. Y.*
FREIDRICH DESSAUER, M. D. ..... *Frankfurt, Germany*
COSTA FORSELL, M. D. ..... *Stockholm, Sweden*
ARIAL W. GEORGE, M. D. ..... *Boston, Mass.*
ISAAC GERBER, M. D. ..... *Providence, R. I.*
CLAY E. GIFFEN, M. D. ..... *Boulder, Colo.*
FRANZ GOLDAMMER, M. D. ..... *Berlin, Germany*
RUDOLF GRASHEY, M. D. ..... *Munich, Germany*
FRANZ M. GROEDEL, M. D. ..... *Frankfurt, Germany*
G. FEDOR HAENISCH, M. D. ..... *Hamburg, Germany*
MARTIN HAUDEK, M. D. ..... *Vienna, Austria*
GUIDO HOLZKNECHT, M. D. ..... *Vienna, Austria*
ARTHUR F. HURST, M. D. ..... *London, England*
ALBAN KOHLER, M. D. ..... *Wiesbaden, Germany*
ROBERT J. MAY, M. D. ..... *Cleveland, Ohio*
E. A. MERRITT, M. D. ..... *Washington, D. C.*
V. M. MOORE, M. D. ..... *Grand Rapids, Mich.*
BENJAMIN H. ORNDOFF, M. D. ..... *Chicago, Ill.*
EMMO SCHLESINGER, M. D. ..... *Berlin, Germany*
W. W. WATKINS, M. D. ..... *Phoenix, Ariz.*
ALDEN WILLIAMS, M. D. ..... *Grand Rapids, Mich.*

BUSINESS MANAGER

H. S. TYLER ..... *305 Arthur Building, Omaha, Nebraska*

RADIUM

Standard Chemical Co.

Applicators of Approved Design
Salts of Highest Purity
U. S. Bureau of Standards Certificate

Our Service is Traditional

Courses of Lectures at Pittsburgh

"The Physics of Radioactivity"
William H. Cameron, M. D.
L. V. Walker, A. B.

"Radium Therapy"
Charles H. Violi, Ph. D.
Arthur L. Miller, B. S., Ch. B.

Information Mailed on Request

RADIUM CHEMICAL CO.

PITTSBURGH, PA.

Boston
Little Bldg.

Chicago
Marshall Field Annex Bldg.

San Francisco
Flood Bldg.

New York
501 5th Avenue

A Reliable X-Ray Vehicle

The Original

Possesses advantages in efficiency, expediency, and palatability.

Very agreeable to the patient.

Excellent physiologic meal for the gastro-intestinal tract. Non-irritating to diseased mucous surfaces.

Samples and literature prepaid

HORLICK'S, Racine, Wis.

Agfa X-RAY

FILM and PLATE

European Standard

Now Available Here from Your Supply Dealer—or

SAGAMORE CHEMICAL CO.
213-215 Water St. New York City
AMERICAN DISTRIBUTORS

WHY EXPENSIVE EXPERIMENTS? USE

Gehler Folie Intensifying Screens

GEHLER·FOLIE
(GUARANTEED GENUINE)

GEHLER FOLIES have stood the acid test for over 14 years
GEHLER FOLIES are used by known Roentgenologists all over the world
GEHLER FOLIES are faster in action
GEHLER FOLIES are absolutely grainless
GEHLER FOLIES have a very hard and glossy surface, assuring long life
GEHLER FOLIES have always been washable

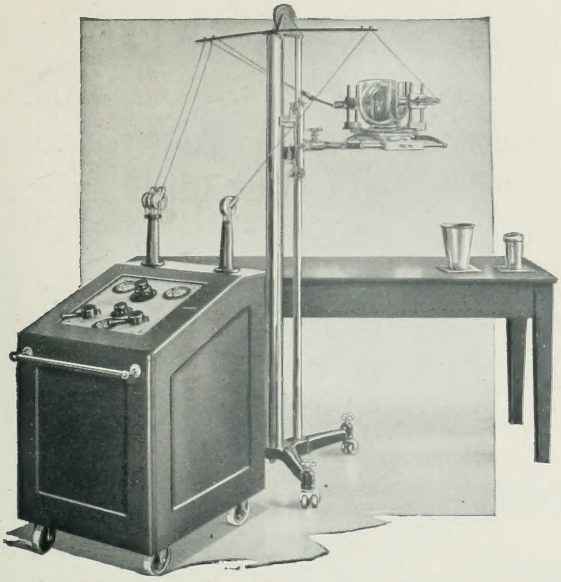
NOT HIGHER IN PRICE — BUT HIGHEST IN QUALITY

Order from your Dealer or direct from the General Agency

JNO. V. DOEHREN CO.

208 No. Wabash Ave. Chicago, U. S. A.

Mail us your Cassettes: we will mount correctly new Screens: Free of Charge



THE COMPLETE INTERMEDIATE EQUIPMENT

Fluoroscopy — Radiography — Radiotherapy

The Intermediate is the only machine using the ROTARY WAVE SELECTOR, the new rectifying device which operates in the secondary circuit and makes it possible to deliver *a unidirectional high tension current from the secondary terminals of the transformer directly to the tube.*

The use of the ROTARY WAVE SELECTOR permits this unit to be made but one-half the size of any other machine of the same capacity. It delivers 40 ma. at a 6 inch gap for radiography and 1 to 5 ma. at a 9 inch gap for therapy. The cabinet is 31 inches high, 22 inches wide and 26 inches deep. It is mobile.

Have you investigated the distinguishing characteristics of the Intermediate?

Write for Booklet "B"

THE HIGH TENSION TRANSFORMER
—AND—
EQUIPMENT CORPORATION

Factory—Hoboken, N. J. *New York Office—212 East 23rd St.*

—Distributors in principal cities—

Ideal For Your Hospital!

Just one of the many places where the DupleXray fits in. You can do all radiographic and fluoroscopic work with the DupleXray. It's easy to control and the new K-K motor-drive tilt table permits your obtaining any position automatically.

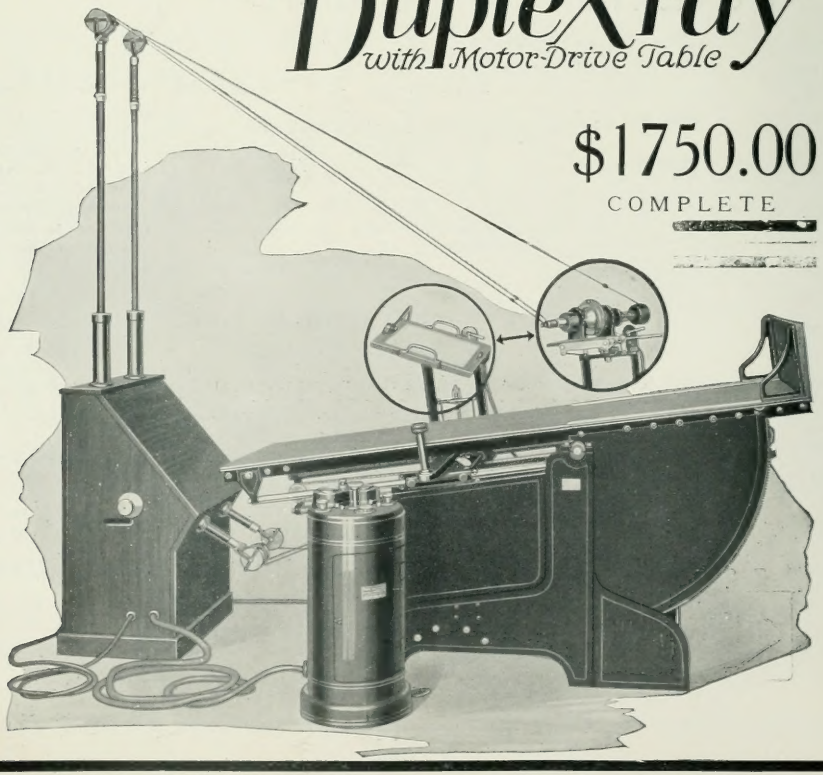
The DupleXray deserves your serious consideration. Our quantity production makes the price satisfactory. Write us for complete details and facts.

THE ENGELN ELECTRIC COMPANY, 4639 Euclid Avenue, Cleveland, O.

The **DupleXray** *with Motor-Drive Table*

$1750.00

COMPLETE

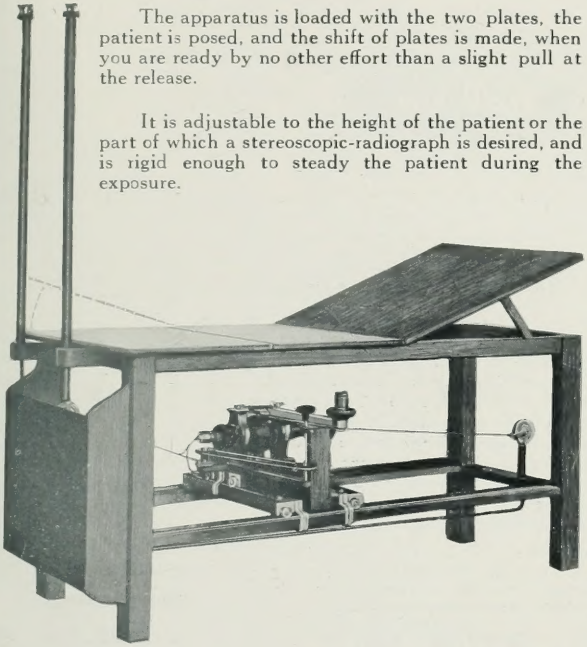


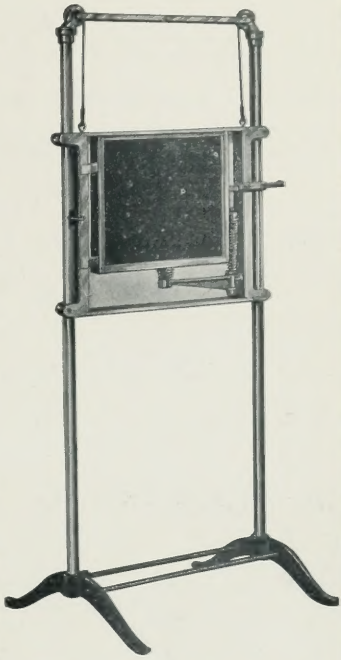
The Solace Stereoscopic Plate Changer

This is a device for presenting to the X-Ray in easy and rapid succession, two plates or films as is necessary in radio-stereoscopy.

The apparatus is loaded with the two plates, the patient is posed, and the shift of plates is made, when you are ready by no other effort than a slight pull at the release.

It is adjustable to the height of the patient or the part of which a stereoscopic-radiograph is desired, and is rigid enough to steady the patient during the exposure.





The Solace Hospital Fluoroscopic Table

This very popular apparatus embodies unusual convenience and protective features. The control of the milliamperage, the size and shape of area of patient exposed to the X-Ray, are under the control of the operator during observation.

Requests for further information solicited.

Waite & Bartlett Manufacturing Company

Factory and Main Office
53 Jackson Avenue, Long Island City, New York

New York Office — 103 Park Ave., New York City
Austin, Texas (Oliver Brush) — 708 Colorado Street
Boston, Mass. (Clapp-Anderson Co.) — 18 Boylston Place
Mexico City (Aztec Electric Co.) — Apartado No. 1300 la de Bucareli, No. 24, Mexico D. F.
Tampico (J. B. LaRiviere) — Apartado No. 217
Monterrey (L. M. Carranza) — Apartado No 316 5 de Mayo 172
Melbourne, Australia (Stanford X-Ray & Radium Co.) — 218 Russell Street

The Mark of a Complete and Careful Radium Therapeutic Service

EXPERTS

Throughout our laboratories, experts are in charge. Men of high technical education and ability who are imbued with the spirit of maintaining the highest standards. Every facility is at their command. They are constantly studying your requirements. Consequently each of our applicators, when it comes to you, represents the highest possible perfection and is worthy of your complete faith.

RADIUM SALTS OF HIGHEST PURITY FURNISHED IN NEEDLES, TUBES, OR PLAQUES OF THE FINEST QUALITY AND WORKMANSHIP. REPLETE WITH SKILLFULLY DESIGNED INSTRUMENTS AND SCREENS TO FACILITATE EFFECTIVE APPLICATION.

WRITE OUR NEAREST BRANCH OFFICE

THE RADIUM COMPANY OF COLORADO

RADIUM BUILDING, DENVER

BRANCH OFFICES

NEW YORK
244 MADISON AVE.

CHICAGO
853 PEOPLES GAS BLDG.

SAN FRANCISCO
582 MARKET ST.

PARIS
118 AVE. DES CHAMPS ELYSEES

The JOURNAL OF RADIOLOGY
Omaha, Nebraska
VOL. III AUGUST, 1922 No. 8

Radio-Toxemia---Its Cause and Suggestions for Its Prevention

EMIL G. BECK, M. D., F. A. C. S.
Chicago, Illinois

THE problem of radiotherapy would be much simplified if it were not for the danger of roentgen or radium toxemia, which is one of the greatest obstacles in the employment of radio-active agents.

As a prerequisite for the solution of this toxemia problem, we must first familiarize ourselves with the following questions: (1) What are the symptoms of radio-toxemia? (2) What is its cause? (3) How can it be prevented?

Before we can answer these questions with any degree of certainty, we must learn to understand the effect of radio-active substances or x-ray upon the normal cells of the body and also upon pathological structures, such as diseases or tumors.

I.

Symptoms of Radio-Toxemia

From the earliest times of x-ray and radium therapy, it has been observed that patients may become ill shortly after the application of the radio-active agents. The severity of this illness is dependent upon the dosage of either x-ray or radium. Large doses or over-doses have led even to fatalities.

The principal symptoms are increased lassitude, often so marked that the patient can scarcely lift his head or arms; he has a feeling of dizziness, and in the more severe cases there is palpitation, nausea and cold sweats. I have seen cases so ill after large doses of radiation that they reminded me of patients who are nearing exitus from general septicemia. At the height of the toxemia the patients usually develop a diarrhœa, even when they have previously been constipated. The symptoms usually appear twenty-four hours subsequent to the treatment, at times earlier if the patient is either in poor condition or susceptible to the poison. These symptoms persist for three or four days, when the patient begins to develop some appetite and the other symptoms become less marked every day, so that within ten days to two weeks they have practically disappeared. The intensity of the symptoms and their duration vary considerably, depending, of course, upon the degree of intoxication.

Animal Experiments

The same symptoms that were noted in patients have also been produced in the lower animals by radiation. Experiments of Doctors C. C. Hall and C. H. Whipple [1] with Coolidge tubes on dogs have given the following results: There was a latent period in almost all cases of twelve hours to two days, during which time the animals appeared perfectly normal. After this period there was a marked vomiting, diarrhœa and loss of appetite; but water was taken eagerly. The maximum intoxication appeared on the fourth day and usually terminated in death. If the animal survived the fourth day, it would usually recover.

The anatomical changes were as follows:

Spleen: Decreased in size, fibrous and contained fewer lymphocites.

Bone Marrow: Decreased in all cells. No constant abnormalities.

Gastro-Intestinal Tract: Contents slightly blood tinged or even quite dark in the colon; but no ulcers of any kind.

Stomach: Usually normal.

Small Intestine: Mottled mucosa with patches of congestion often more marked in the jejunum.

Colon: May be contracted and some patchy congestion.

Crypts: Show degenerated epithelium and large clumps of polymorphonuclear leukocytes grouped about this epithelium.

Another interesting experiment has been done by Dr. H. J. Mack [2] by injecting the active deposit of radium into the veins of animals. They were first affected with digestive disturbances such as vomiting and diarrhœa, associated with considerable loss of body weight. In some cases there was a rise of temperature, suggesting a reaction on the part of the animal organism to meet the toxic condition produced by a considerable amount of destruction of cellular material. When same doses of radio-active solution were again administered after the animal had apparently recovered from the first large injection, the same symptoms recurred. The organism is, therefore, not immunized against the action of a subsequent injection of radium; on the contrary, the symptoms are more marked on account of the cumulative effect from the previous poisoning.

In our experience we have noticed that patients who have passed through the toxemia and seem normal are just as susceptible, if not more so, to a repeated attack of toxemia than they were at first. At times one is uncertain as to whether the patient has a radio-toxemia or whether he is ill simply from the effects of his disease. The symptoms of radio-toxemia resemble very much that of other types of toxemia; especially the one that is associated with the late stages of cancer. To determine which it is becomes a very important factor in such cases, as one is uncertain whether to repeat the radium treatment or to withhold it. My rule has been to withhold treatment when in doubt, because the doubt will be cleared up within a short time. If the patient is suffering from radio-toxemia, he will soon begin to improve, as the toxic products are being gradually eliminated, while a toxemia produced by cancer itself will continue and the patient will constantly grow worse.

II.

Causes of Radio-Toxemia

The term "radio-toxemia" itself suggests its cause. The exposure of the body to the rays of radio-active substances or the x-rays, produces the symptoms just described. The rays, however, are not the actual toxic agents; it is their action upon the cellular structures that produces the toxic products. Each cell and fiber of the body (whether normal or pathological) will undergo a certain change when subjected to radiation. What form of change will take place is dependent upon the dosage of radiation and the time of exposure, and also upon the radio-sensitiveness of the cell itself. Some cells are highly radio-sensitive while others are radio-resistant. In other words, some cells are readily affected by the x-ray, while others are not. When the dosage of radiation is small little damage will be done to either the normal or the pathological cells, but as the dose is increased the damage to the

cells will increase until finally they will be destroyed.

This contradicts the assumption that the rays have a selective action upon certain cells. The rays themselves have no selective power; they bombard all structures alike and injure more or less all living organisms. It is the resistance of a particular cell which determines whether it will survive a certain dosage of radiation or whether it will merely be wounded and apt to recover.

The end products of cellular or fibrous tissue destruction are highly toxic, and since they must be absorbed into the circulation before they can be eliminated, they produce the toxic symptoms described.

This leads us to a most interesting observation of cellular changes as a result of radiation in cancer therapy, described below: *Morphologic and biologic changes of normal and cancer cells after radiation:* (a) stimulation, (b) sterilization, (c) death of cell.

A thorough knowledge of the histological changes in the tissues occasioned by radiation, is not merely a matter of scientific interest, but is also of extremely practical value. Indeed it is the foundation and a necessity for successful therapy. At first glance it appears to be a simple matter to deduct from the literature and one's own experience, an up-to-date resume of the knowledge of this subject; but as we begin to analyze the work of many investigators, we meet with such a vastness of special investigation that we can here only mention those facts which are essential for practical purposes in this work.

In the application of radium or x-ray we must take into account the fact that the body consists of two kinds of tissues: First, the stationary such as the bones, muscles, secretory, excretory and digestive organs, the connective tissues, etc.; and second, the migratory or circulatory tissues such as the red blood cells, the leukocytes, lymphocytes, etc.

When radiation is concentrated upon a certain area in the body, the rays bombard the stationary tissues, but inasmuch as the blood constantly circulates through this part of the body, the blood cells must of necessity be affected also. As the blood stream passes through the radiated part, the cellular constituents of the blood as they pass through receive a charge of the radiations. It is thus evident that deep therapy affects the entire volume of blood in the body.

Some Factors Which Determine the Tissue Changes

1. Dosage of radium or x-ray at source.
2. The distance of the radio-active substance or the anode from the body.
3. The length of time of exposure.
4. The thickness of the intervening tissues.
5. Interposition of artificial filters, their density and thickness.

Figure I.—Wound left open for subsequent application of either x-ray or radium.

Results of Radiation upon the Tissues

1. Small amount of radiation has the tendency to accelerate the growth of the tissues; it causes proliferation of the cells. (This has been contested.)
2. Larger doses will paralyze the reproductive power of the cells and thus retard or entirely inhibit the growth without actually destroying the life of the cell.
3. Massive doses will destroy the life of the cell. It is disintegrated and the end products are absorbed in the body and eliminated through the excretory organs.

This applies to all living cells, but some cells are more resistant than others to radio-active application.

Changes in Normal Tissues: The investigations of this subject began when in 1898 Professor Albers Schoenberg introduced the x-ray for metrorrhagia in cases of myoma of the uterus. It was discovered that the women so treated became sterile and histological changes took place in their ovaries. These changes were studied by Halberstaedter, Schiffmann, Levant, Regaud, Huessy and Wallart, Rost-Krueger, Edelberg and others.

Figure II.—Tumescence enlarged to size of large grapefruit.

It was found that through the energy of the rays considerable destruction of epithelial cells of the follicles took place and that the ovum became succulent and the nucleus broken up, and thus the cells were killed. Some varieties of normal body tissues proved to be only slightly affected or injured by radium or x-ray except when very large doses were applied. The cornea for instance is only slightly radio-sensitive. The brain cells are spared while intercranial tumors treated by radio-therapy may disappear.

By radiating turtles and frogs Levin[3] found that the lymphocytes of the circulating blood were more radio-sensitive than the leukocytes and erythrocytes, a release of the polymorphonuclear leukocytes from the bone marrow, and an over production of the same by the blood forming organs.

This specific radiosensibility of lymphocytes explains the action of radium and roentgen rays on normal and diseased lymphoid tissues. The destruction of the lymphocytes in the lymphoid tissues is associated with

Figure III.—Inspection of cavity, showing bronchial opening.

endarteritis obliterans and finally the formation of dense connective tissues.

Changes in Pathological Structures: Normal lymphoid tissue is less radio-sensitive than the various types of hyperplasias, bacillary infections, lymphomas and sarcomas. Hodgkin's disease and lymphosarcomas are extremely radio-sensitive and enlarged spleens shrink to normal size under radium and x-ray influence.

The changes in cancer cells were studied by Handley of Bonn[4]. He compared the microscopic sections of a carcinoma that had been rayed for three weeks with those of the same tumor which had not been rayed. In the rayed specimen small groups of carcinoma cells were surrounded by connective tissue. The individual cell was larger and flat and on account of the large amount of protoplasm in each cell, the entire specimen seemed much paler. In large magnification it seemed edematous and did not take the stain very deeply so that the finer structures of the cell were not clear while a number of other cells were full of vacuoles and stained faintly. Even the protoplasm varied in its intensity of staining, one cell being brighter than another. The outlines of the cells were rather sharp. Karyokinetic changes were found very rarely after radiation; but at times there was abnormal proliferation of the cells. In cases where radiation was kept up for a long period further changes took place. The carcinoma cell groups began to diminish in size; the connective tissues increased, and in a great many of the cells there were fine black spots something like dust sprinkled throughout the entire cell. This was no doubt due to destruction of the nucleus, the nucleus becoming smaller and smaller until it finally disappeared, and nothing but the protoplasm was left which finally also disintegrated. Some of the cells, however, remained almost normal.

Dr. Joseph Beck and myself have been able also to verify the findings of Handley in several cases of carcinoma which had been radiated. Apparent recurrences such as glands in the neck, easily palpable, remained stationary after radiation. The health of the patients was not in any way impaired; on the contrary they kept on gaining in weight.

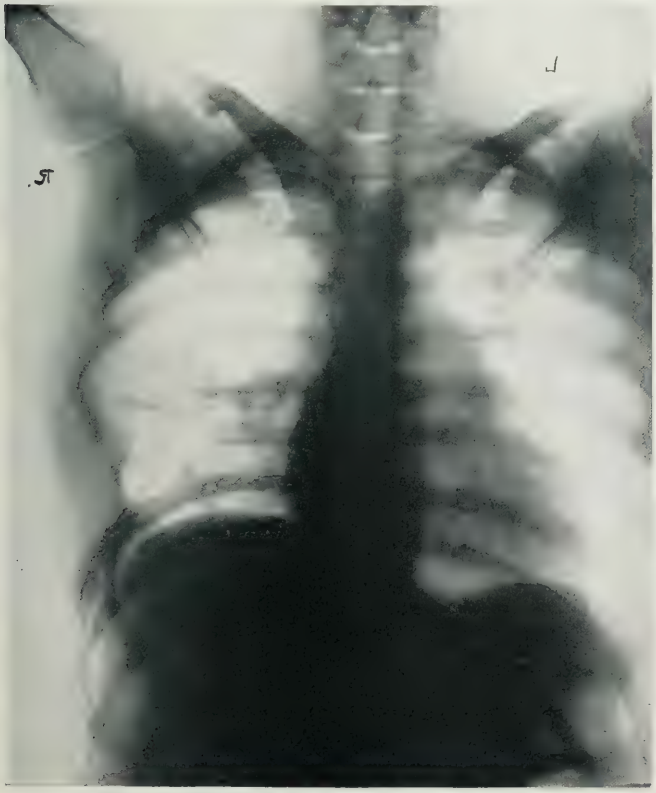


Figure IV.—Four weeks after operation. Small remnant of tumor mass and tumor wall very thin.

III.

Prevention of Toxemia

If this can be accomplished it will mark a great advancement in radio-therapy. I desire to make some practical suggestions which may bring us nearer to its solution.

In the superficial growths such as epithelioma of the mucous membrane or skin, or in cases where small dosage of rays is employed, the danger of toxemia is negligible; but in deep-seated growths of large size such as tumors of the lungs and liver, or in Hodgkin's disease, the danger is great and we are

faced with a difficult problem. If we administer smaller doses than necessary for the complete destruction of every malignant cell, the treatment is almost useless, and if we give such dosage as is required to kill all malignant cells then the damage produced by the toxic products due to the breaking down of diseased as well as normal tissues, is so severe as to endanger the life of the individual.

When a tumor deeply seated in the body is to disappear through the action of the radium it must first become liquefied before it can be absorbed. In other words, each cell of which the tumor is composed before it can be eliminated must first die and be reduced into an absorbable liquid which can be taken up by the lymphatics and carried through the blood stream until it reaches the excretory organs, the kidneys, the skin and the lungs. Just as the solid foodstuffs we eat must first be transformed by the digestive organs into a liquid and carried through the body before they can be finally transformed into the cellular or fibrous structure of our body, so must all cells and fibers be first liquefied before they can be eliminated.

We have already stated that this rapid breaking down of the tissues causes toxic products which are the actual cause of the symptoms described as radio-toxemia, and since the process of breaking down is a protracted one lasting from one to three weeks the elimination of the toxic products is at times unable to keep pace with the rapidity of formation of the poisonous material. In other words, the poison forms faster than it leaves the body, and thus accumulates.

Rapid elimination is of course a very essential part of the treatment. The kidneys and skin must be kept active without relaxation. Water in large quantities is to fill the arterial tree and the flushing of the bowels is very important in order to get rid of every possible atom of the poison. There are no antidotes known to counteract the harmful effect of the toxic product, elimination from the body is the only remedy.

I have, however, a more practical suggestion than this treatment. Its name is Prevention. I am sure that the toxemia may be prevented in most cases. *If we are able by radical surgery to expose the tumor and remove as much of it as is consistent with safety to the patient and then leave the wound open no matter how large it may be, so as to be able to give direct application of the radio-active agent into the cancer bed, we may prevent the toxemia.*

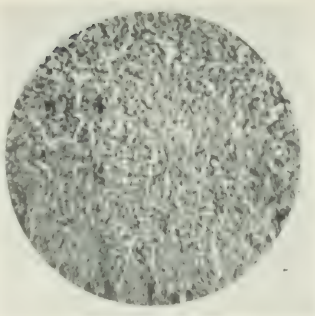


Figure V.—Microscopic section, showing spindle cell sarcoma.

The surgical procedure is, as follows: *We remove the skin, the fat and the muscles and as much of the tumor as is safe or possible.* This sometimes leaves a perfectly clean field and no visible remnants of the growth; at other times, it is possible only to remove part of the growth because it is attached to or imbedded in vital organs. No attempt is made to diminish the size of the wound by sutures. The wound is left open for subsequent application of either x-ray or radium, as the case may be (Fig. 1). This condition establishes a condition very similar to and as favorable for treatment as in the superficial growths, and we may expect, therefore, similar results.

Allowing this large area to remain widely open, we may now apply the rays either with the x-ray or by placing radium directly into the bed of the disease. It is now unnecessary to do any material screening, especially when there are large remnants of the diseased tissue left. We have by this procedure eliminated the danger of skin burns and may with safety place radium in direct contact with the tissues which we wish to destroy. Screening becomes necessary only when we have large blood vessels, vital organs or nerves in close proximity to the open wound. The dosage of radiation employed may now be reduced to one-tenth the quantity which would have been required if the applications were made through the skin, for the reasons already mentioned.

It is easy to comprehend why the toxemia should not appear when this form of treatment is employed: *First*, we can usually remove with the knife the greater part if not all of the growth

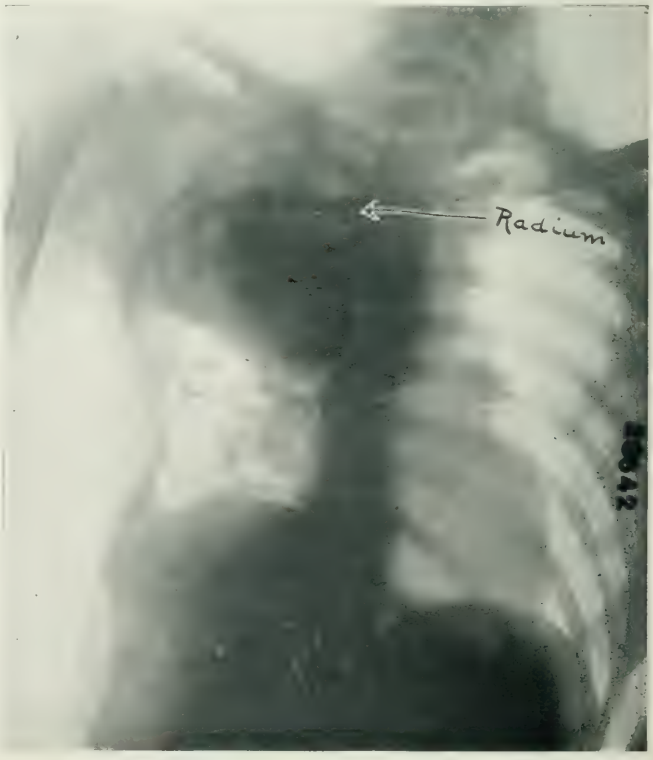


Figure VI.—Recurrence in right apex.

Figure VII.—Exposed lung cavity, showing beginning of new growth.

Figure VIII.—Malignant ovarian cyst.

Figure IX.—Application of radium through funnel shaped crater into the interior of the cyst cavity subsequent to operation.

which in itself takes away one of the main sources of the toxic products. *Secondly*, in treating this open field or cancer bed with the radio-active agents, we need not apply nearly the dosage which would be required if the overlying tissues (often three or four inches in thickness), were covering the tumor mass. *Thirdly*, whatever decomposition takes place as a result of radiation in the crater of the wound, is now drained into the dressings instead of being taken up into the circulation. These are three important factors, each of which alone might prevent the toxemia; but combined, in my experience, they have almost eliminated the danger of the poisoning in question.

I cite here only three cases to illustrate the method employed and trust it will appeal to the reader sufficiently to recommend it to the patient in suitable cases. The objection to this procedure is, of course, the operation. Patients dread to be operated, it is true; but they likewise dread a toxemia and they have a better chance to get well if the radiotherapy is doing what is claimed for it.

CASE I.—*Sarcoma of the Right Lung —Removal of Interior of Tumor; Subsequent Radium Therapy Within the Cavity.*

Patient was referred to me on September 28, 1920, with the following history:

She was then 23 years of age, unmarried, and her best weight was 126; present weight, 124. Examination of sputum revealed no tubercle bacilli. Wassermann negative; complete fixation for tuberculosis negative. Afternoon temperature 99.1°. Physical examination showed a few moist rales over the right hilus in front and back with no change in the percussion note. There was slight enlargement of the thyroid. The stereoscopic x-ray examination of the chest showed a well defined, clean-cut hilus shadow in the center of which was another round shadow about the size of a twenty-five cent piece. It was so round in shape and abrupt in its outer margin as to attract attention. It was not typical of tuberculosis or of anything which involved the lung tissue proper. In three weeks the fever and sputum had disappeared, and the patient resumed her work as a nurse.

On September 10, 1920, the patient had another attack, cough and some hemoptysis followed by bloody sputum for several days and an elevation in temperature. During this time the pupils were dilated. The physical signs were more definite over the right lung, and the x-ray showed that the tumescence had increased and was as big as a grapefruit (Fig. 2). Present weight 116.

October 15, 1920. Primary operation (under general anaesthesia): A skinflap including muscles and fat seven inches in diameter was raised. Six inches of each of the fifth, sixth and seventh ribs were resected, exposing the pleura over the tumor mass. The exposed pleura was then cauterized with silver nitrate stick to produce adhesions between the tumor and the pleura.

October 18, 1920. Secondary Operation: The wound was exposed and a pursestring suture placed in the centre of it to insure quick closure in case there should be uncontrollable hemorrhage. The tumor wall was then incised; the capsule was rather firm but the interior of the tumor was composed of a semi-solid brainlike tissue, somewhat more solid, but not homogeneous, with more solid portions than softer portions. It was possible to evacuate the contents in a manner similar to delivering an adherent placenta. The cavity was quickly packed with twelve soft gauze sponges. Patient left the operating room in good condition.

After Treatment: Forty-eight hours later the twelve soft gauze sponges were removed under anaesthesia. There was no hemorrhage. We removed another four or five ounces of the tumor mass from certain recesses of the enveloping capsule. The cavity was repacked. One week after the operation fifty milligrams of radium were introduced into the cavity in the centre of a rubber ball, giving six hundred milligram radium hours (Fig. 3). The wound was dressed daily and the following dose of radium was introduced on the following dates:

October 28, 1920. . . . 600 mgr. hours
November 8, 1920. . . 425 mgr. hours
November 18, 1920. . 450 mgr. hours
December 13, 1920. . 400 mgr. hours
December 22, 1920. . 300 mgr. hours
January 14, 1921. . . . 450 mgr. hours

This dosage would appear small if the radium were heavily screened. Without much screening the dosage actually delivered is many times what the figures would indicate.

The patient continues to improve and the cavity has shrunken to one-twentieth its previous size. There are some small necrotic masses resembling degenerated sarcoma. The bronchial opening is still present, and when the patient inhales there is a discharge of a serous mucoid substance.

Stereoroentgenograms taken (Fig. 4) four weeks after the operation show only a small remnant of the tumor mass, and the tumor-wall very thin.

Figure X.—Epithelioma of the lower lip involving the glands of the neck.

Figure XI.—Introduction of radium into the open wound and beneath the skin.

Figure XII. — Section of upper lip prepared for later plastic operation.

Figure XIII. — Cross-fire application of radium.

Figure XIV. — Illustrating the patency of the mouth.

Pathological Report: The microscopic section of the tumor showed a spindle-cell sarcoma (Fig. 5).

After one year another roentgenogram was taken and it showed recurrence in the right apex (Figs. 6 and 7). The patient, however, appeared in good health, although she had pain in that region. In the roentenogram we note three radium needles embedded in the tumor; they represent thirty-seven and one-half milligram radium hours embedded without screening directly into the tumor. They were left in for ten hours. The reaction from this relatively small amount of radiation was, to our surprise, very marked. The patient developed fever and had all symptoms of toxemia within a few days after the treatment. The symptoms began to be alarming and large doses of morphine had to be employed to stop the pain.

November 25th I decided to enter this cavity by means of a cautery. I made a large opening into the tumor, through which I introduced my finger, and scooped out a part of the contents of the cavity, tightly packing with gauze to stop the hemorrhage. The patient felt much relieved immediately after she came out of the anaesthetic. One hundred milligrams of radium were inserted into this cavity in the same way in which it was done after the first operation a year ago. This time it was left in for fourteen hours. There was but one millimeter of silver capsule screening.

When we compute the amount of actual radiation issued and absorbed by the tissues when the radium is applied in this manner, namely within the cavity, the total amount actually absorbed is much greater than it would appear.

We have figured that the amount was at least ten times as large as it was at the time when three needles (thirty-seven and one-half milligrams) of radium were introduced into the tumor some weeks previously. Nevertheless the large dosage did not produce any toxemia while the introduction of the thirty-seven and one-half milligrams of radium into the tumor produced a heavy toxemia.

The reason for this is very clear. The products of decomposition could in the latter application escape freely through the large opening in the cavity while the introduction of the needles into the center of the tumor gave no chance for escape of the products of decomposition, and the same had to be absorbed and circulated through the blood before they could be eliminated.

CASE II. — *Malignant Ovarian Cyst (Cyst Adenoma) Treated by Open Method.*

Mrs. E. S., 66 years old, entered the hospital March 10, 1919. Since December, 1918, she had noticed that her abdomen had grown to a very large size. She lost control of her bladder and lost considerably in weight. Her legs were swollen up to her knees. The diagnosis had already been made by her physician of a malignant ovarian cyst.

An exploration was made, the diagnosis was confirmed, and the case was considered inoperable. There was some fluid in the abdomen and intestines, and the enormous tumor was matted with intestines and studded with small growths resembling papillomata.

The abdomen was closed. She received x-ray treatment for six months, which did not benefit her, for no effect was produced. The abdomen grew larger and larger until she could hardly breathe (Fig. 8). In her desperation she insisted upon an operation, and the same was performed November 15, 1919, as follows: Median incision from the ensiform cartilage to the pubes to deliver the tumor out of the abdomen. The loops of the intestines were firmly adherent to the base of the tumor.

The tumor itself was firmly attached to the entire pelvis and thus was not removable in its entirety. The cyst was, therefore, opened and its contents, a gelatinous mass, removed (about five quarts in quantity).

The upper two-thirds of the tumor was then amputated. The wall of the tumor was two or three inches thick in certain portions and thinner in other parts. The edges of the skin were sutured to the rim of the amputated cyst and the cavity packed with gauze so that there was a funnel-shaped cavity reaching the lowest part of the pelvis.

The interior of the cyst was then treated by direct application of radium at intervals of three weeks — seven hundred to eight hundred milligram radium hours being given each time. The radium treatments were supplemented with deep therapy, one erythema dose being given every second day.

The cavity gradually diminished in size by contraction of its walls and absorption of the tumor, and the patient gained in general health and strength.

The abdominal opening into the cyst remained open for sixteen weeks in a suppurating condition, but finally closed, remaining so up to date—nearly a year and a half after the operation.

The patient is now attending to her daily housework, and has been able to take care of a very sick husband for nearly four months.

Fig. 9 shows introduction of radium into the cavity by curved applicator. Comments:

(a) By eversion of the interior of a malignant cyst, we transformed an intra-abdominal into an external abdominal tumor, and thus were able to apply x-ray and radium directly into the seat of the malignancy.

(b) It is safer to treat the tumor in this manner compared to the attempt of complete enucleation.

(c) It is preferable to treat with radium combined with x-ray than either alone.

CASE III.—*Epithelioma of Lower Lip With Involvement of the Glands of the Neck.*

Patient, fifty-three years of age, presents a large ulcerated growth involving the entire lower lip including

the angles of the mouth. He is unable to retain the saliva and has difficulty in eating. The right submaxillary gland is the size of a hen's egg. Patient lost considerable in weight and strength.

Past History: The ulcer first appeared a year ago, in the region of the mucocutaneous border, and gradually grew to the present size (Fig. 10). It was first diagnosed as syphilis, although the Wassermann was negative. An extensive anti-syphilitic treatment produced no results.

Treatment: Operation August 13, 1920. Excision of the entire lower lip and both angles of the mouth, and that part of the right cheek containing the nodule with a good margin of normal tissue. The incision was then carried to the neck and exposed the region of the gland involvement. The entire area was thoroughly exposed and all glands removed. A suture was made from the angle of the lip to within one inch of the lowest point of neck incision (Fig. 11). Rubber drain was introduced to leave the channel for radium introduction. No attempt was made to reconstruct the lower lip, at this time. It will be noted that we left the entire surface open and exposed to facilitate application of radium and bring direct action on same in cancer bed.

Radium treatment was begun a week after operation. A tube of fifty milligrams was inserted for four hours into the lower lip wound and twenty-five milligrams into the channel left in the lower border of the wound in the neck. Application of same dosage was repeated three times at intervals of two weeks—a total of one thousand four hundred milligram radium hours. The region of the neck was treated weekly with x-ray exposures of four minutes and spark gap of eight inches at intervals of three days.

In Fig. 12 we note the provision that was made for later plastic operation. A section each side from the upper lip each about one-half inch long was prepared to cover the defect in the lower. No suturing was done, the two nipple like portions being allowed to drop down towards the raw surface of the lower lip.

In Fig. 13 we demonstrate the application of radium in the recess of the gingiva.

In Fig. 14 a complete healing has taken place. The border of the mucous membrane from the gingiva has joined the border of the skin of the wound edges of the chin. The patient is able to open his mouth widely.

Such surgical procedure must of necessity often be very extensive and therefore connected with some risk. A half way procedure will not do in such cases. It was a surprise to us, however, to find that the immediate mortality was not as large as one would expect. It is not necessary, however, to describe the technique because this varies in each case and the illustrations which accompany the case reports are sufficient to give this information. If the principle appeals to the trained surgeon he will be able to devise his own plan in each case.

I have carried out this procedure in more than one hundred cases, in a group which usually carries with it a one hundred per cent mortality, in other words, recurrent cancer, or cases so far advanced as to be regarded as inoperable. I have not had a fatal case from toxemia in the past two years, while in the previous three years four of our patients succumbed to toxic symptoms. I have made several reports of this work [illegible] with citation of cases illustrating the surgical technique and radiation.

I trust that this small contribution toward the prevention of toxemia, will stimulate others to work it out further as it will be the means of extending the use of radiotherapy to a class of cases in which previously it was not even attempted.

In conclusion I will say that while we have saved only a limited number of this group of cases, many of them were made a great deal more comfortable while they lived. We feel, however, that we have done harm to none and have benefited a few. We attribute the possibility of carrying out this procedure, mainly, to the prevention of toxemia.

Bibliography

1—Hall, C. C. *and* Whipple, G. H.: Roentgen Ray Intoxication, Am. J. M. Sc., 157: 455, April 1919.

2—Bagg, H. J.: Response of Animal Organism to Repeated Active Deposit of Radium Emanation. J. Cancer Research, 5:301, October, 1920.

3—Levin, Isaac: Action of Radium and Roentgen Rays on Normal and Diseased Tissue, Jour. A.M.A., 77: 930, September 17, 1920.

4—Strahlentherapie. Volume 1, Number 1.

5—Beck, E. G.: Intentional Removal of Skin and Other Tissues, Surg. Gynec. Obst. 29:325, October. 1919.

6—Beck, E. G.: Radical Surgery as an Aid to Efficient Radiotherapy in the Apparently Hopeless Cases of Carcinoma, Internat. Clinics, 2:46: 1921.

7—Denudation of Inoperable Cancer as an Aid for Efficient Radiotherapy, Minnesota Med., 4:360. June, 1921.

Teamwork Between the Roentgenologist and the Pathologist

H. L. ROBERTSON, M. D.
Mayo Clinic, Rochester, Minn.

It is well at all times to pause in our frenzied search for new things and examine the fundamentals of our chosen field, scrutinize its limitations, criticize its accomplishments and, in short, set our own house in order. The need for such a procedure is especially emphasized in the various specialties which make up the practice of medicine. Such a review, however, must be undertaken by those who are within the particular group under examination and pathology has so many troubles of its own that one of its disciples could ill assume the role of an investigator of other and equally independent fields.

The desirability of establishing more securely the fundamental aspects of any medical specialty is, nevertheless, a dominant one and it is my purpose to review in some of their main features the points of contact which may be maintained between the specialties of roentgenology and pathology. This task is undertaken not because there is any indication that roentgenologists in any way lack a strong interest in promoting the advancement of the scientific aspects of their practice, but because I am certain of your desire to seize every possible opportunity to further the ideals of our common interests, namely the protection of life and health by the most efficient methods.

My interest in the possibilities of co-operative team play was first aroused by some work which was undertaken in 1906, under the direction of that distinguished and beloved veteran of our profession, Dr. Francis H. Williams, of Boston. Together we carried out a series of roentgen-ray exposures on the chests of bodies which were to be examined later and carefully correlated the readings of the plates and the actual results of the gross and microscopic examinations. So many valuable results were obtained by this method that further extensions were planned, but these were interrupted by my leaving Boston for work in the Middle West. Many years elapsed before the subject again assumed, as it seems to me, even greater importance.

When the epidemic of influenza attacked our soldiers in France, it soon became apparent there, as no doubt it did later in this country, that our best clinicians were very greatly embarrassed in their efforts to arrive at accurate conclusions as to the exact conditions in individual chests. Old time methods of physical diagnosis embodied under the terms inspection, percussion, and auscultation (with a due modicum of imagination) proved woefully inadequate in the presence of the insidious plague which was so ruthlessly decimating our forces. These failures often resulted in sending to the morgue the bodies of soldiers whose death was attributed to lobar pneumonia when as a matter of fact the postmortem examination revealed frank empyema, a condition in which active interference, which always promises some hope of relief, had been denied. This denial was the direct consequence of wrong diagnosis and the wrong diagnosis was not always because due care or even professional skill had not been exercised, but because the inaccuracy of the older methods, unaided, was revealed on a scale such as perhaps has never before been reached.

The necessity for aspiration of all chests presenting respiratory diseases, or, better, for calling in the aid of the roentgenologist soon became apparent and the utilization of the roentgenogram in acute conditions of the chest became as routine and needful in making a proper diagnosis, as it had formerly been in the more chronic conditions. Portable apparatus was taken into the wards and soon became a most efficient adjunct to the diagnostic measures used by the more progressive of our medical officers.

Here again a further difficulty was presented which also directed attention to the inherent limitations of medical science which not only demands that all the lore of the past be mastered but that room be left in every field for the acquisition of new facts. In the influenza epidemic we were dealing with an almost entirely new entity and the interpretation of the clinical and roentgen-ray findings presented new problems, which had to be solved and mastered, in addition to the thousand and one complications presented by former diseases. When, therefore, in the hospitals in which I was working, it was proposed that careful comparisons be made of both antemortem and postmortem plates with the actual pathologic conditions presented at the autopsy, the most enthusiastic co-operation was secured. Almost daily conferences and discussions were held in which the lessons learned at postmortem were transferred by the clinicians and roentgen-ray workers to the wards and more painstaking and, let me emphasize it, life-saving work was accomplished. Our army roentgenologists were willing and anxious to co-operate. Indeed, the whole story can never be adequately told of the accomplishments of this group of men who worked under the most discouraging conditions, with lack of equipment, lack of trained assistants, lack of suitable quarters and, worst of all, lack of that atmosphere of hearty appreciation of needs and deeds without which the modern medical man can hardly be happy in his work. I cannot resist this small appreciation of the magnificent spirit and the splendid results produced by the workers in this important field of our army medical life.

The transfer of these methods, so fruitful in results, to the diagnosis of other conditions equally troublesome from the diagnostic standpoint became a matter of course. In the early months of the epidemic sinus troubles were prominent both because of their severity and the menace they held for the production of serious complications. Again, clinical methods were often at fault in the attempt accurately to estimate the nature of the disease processes. Empyemas of sphenoids, frontals and antra were allowed to go unrecognized and the patient's comfort and, perhaps, even life itself were jeopardized. The sinus conditions presented by the epidemic, like those found in the respiratory tract, were so acute and fulminating as almost to constitute a class by themselves. Routine procedures in exposing and interpreting plates were many times proved to be insufficient. Only after careful review of the results of the postmortem with the plates studied by the side of the dead body were our clinicians aware of the difficulties of diagnosis and the seriousness of the lesions revealed by the plates with almost startling accuracy.

One cannot overestimate the by-products of such co-operative activities. The increased training which extended to the entire staff, including the pathologist, the stimulation to early recognition and proper treatament of disease processes, the spirit of team work with the patient's ultimate welfare as the goal, all this developed an *esprit de corps* which is as difficult to produce as it is to describe.

The foregoing examples, taken from actual experience, only serve to hint at

*—Read before The Radiological Society of North America, Chicago, December 10, 1921.

the almost limitless possibilities presented by this sort of combined efforts. Hardly any other method presents so many possibilities of gaining new knowledge, additional skill in interpretation or increased confidence of judgment. So vast and complicated has the science and practice of roentgenology become that even now specialists in this field often devote the major portion of their energies to particular anatomic divisions of the body and acquire special expertness in the diagnosis of conditions of the head, chest, gastro-intestinal or genito-urinary tracts. Such special skill presupposes the most accurate and painstaking knowledge of both the anatomy and pathology of the regions studied. How can such training be more readily obtained than by frequent attendance at the postmortem examination, preferably with the plate which has been interpreted during the life of the patient?

In the head, important factors such as the effects of angulation, the variations in penetration produced by changes in technique as well as the pathologic changes in bone and soft tissues, the proper interpretation of pathologic conditions of the sella turcica, the diagnosis of brain tumors and hemorrhages and correct methods of best revealing the multitude of diseases to which the bony sinuses are exposed, all such points and many others are illuminated and clarified by repeated comparisons between the apparent, which is on the plate, and the real, which is in the head itself.

Diseases of the chest present such a complex picture with the almost unlimited possibilities of various combinations of diseases, that the clinical determination of the exact pathologic syndrome which may be presented by the chest of the average adult, is often not only a difficult but even an impossible task. The fact, of course, has been appreciated by the roentgenologists, who with others of the medical profession have labored under the difficulty of inaccurate knowledge with regard to the causes and sequence of disease processes. In both the clinical and roentgenologic fields, over-confident observers have given wrong diagnoses because their judgment was based on insufficient knowledge or experience and thus have thrown disrepute on all branches of the profession.

If a chest at one and the same time may present both fibrous and calcareous plaques in the pleural linings with or without collections of fluid of varying densities, old calcareous masses in the lungs as the remains of tuberculosis in infancy, calcareous changes in the cartilaginous rings of the large bronchi, caseation and calcareous deposits in the lymph nodes around the bronchi, old tuberculous foci at the apices with adhesions and distortion of the lung pulp, dilated bronchi containing dense exudate, emphysema, pneumothorax, atelectasis, infarcts, congestion and edema, to say nothing of tumor nodules of various kinds in the mediastinum and the lungs, with the further conflicting factor of aneurism, then the accurate interpretation of the shadows of these conditions, the separation of the old and finished processes from those that are advancing, the evaluation of the importance of the suggested lesions, demands skill and experience which reaches the height of medical attainment. I am quite ready to defend the thesis that such heights are impossible of successful achievement without the most painstaking collaboration between the pathologists and those who are caring for the patient during life. It is indeed doubtful, whether long and continued experience in the interpretation of plates under the tutelage of masters can be completely substituted for the experience which may be gained from the autopsy, where new methods may be tried out and variations made in experimental work which will help to solve the many problems presented in both technique and diagnosis.

Perhaps the most important disease of the chest and one of which we are constantly reminded is tuberculosis. This disease, by the protean character of its manifestations and the insidious non-symptomatic nature of many of its processes, gives rise to more practical difficulties of exact interpretation than almost any disease with which we have to deal. It was the postmortem examination which taught us the significance and almost universal occurrence of the early lesions of infancy, and the changes which were produced by those lesions in the lymph nodes and pleural surfaces of the lungs. Many misconceptions still remain for clarification with respect to the pathogenesis of the acquired lesions in adult life and the final word has not been spoken with regard to the difference in reaction between the partially immunized and the wholly unprotected tissues of the human body.

Objection has been made that at necropsy only the end results are presented and that none but the pathologist can have any very vital interest in these terminal lesions; the patient is dead, and, by that same token, clinical interest must cease. This is founded on a most superficial and mistaken conception. Patients die from myriads of causes and in a series of routine postmortem examinations will present not only terminal lesions but the beginning phenomena of disease in every organ and region of the body. Indeed the autopsy is almost our only source for acquiring information of the vast array of pathologic conditions which I have been accustomed to group under the term "subsymptomatic" pathology. This includes not only those lesions which may never develop to a stage where any appreciable signs or symptoms will be present, but also the early stages of all the major complaints to which the human body is subject. We often fail to appreciate the extent, both in time and in tissue alteration, which these processes may reach before the patient applies to our profession for relief. For the earlier detection of such, the roentgen ray has become indispensable. How can their significance be properly estimated, however, without exact knowledge of the etiology, developmental courses and tissue changes possessed by these diseases from their insignificant beginnings to their life-menacing ends. Routine roentgenographic pictures of various regions taken at different intervals and studied in the light of what may be revealed at the autopsy would furnish one of the most sound bases possible for the founding of our knowledge and the improvement of our skill.

To a much less degree, the methods which have been indicated apply in the study of the lesions affecting the gastro-intestinal tract. This field represents some of the most brilliant achievements of roentgenology, but even here there remain open numerous questions, not only with regard to pathogenesis but with respect to the development of disease. Such a simple subject as the physiology of peristalsis is still far from clear and there is little wonder that disturbances of this function should lead to many mistaken diagnoses, and, what is more important, errors in treatment.

The exposure of the lesions of the gastro-intestinal tract in the operating room is one cause for rapid advancement in our knowledge. However, this exposure cannot be compared with that which may be accomplished at the necropsy, and various roentgenologic studies of the living patient and even of the dead body before the examination, may give rise to most important and far reaching results.

In the development of new methods, the autopsy is on a par with animal experimentation. This is illustrated by the stage which the diagnosis of genito-urinary conditions has reached. The use of various substances in solution or as gases which will afford more detailed information with regard to body

cavities and tubes, has by no means reached a stage of perfection and one of the most valuable methods by which these new substances can be tried out is in conjunction with the work of the pathologist.

In the field of therapy, whether by the roentgen ray or by radium, the pathologist has always been granted an important place. Much of our knowledge concerning the principles of the therapeutic application of these rays, has resulted from painstaking researches on the microscopic appearances of human and animal tissues. In view of the wide differences of opinion in the clinical world with respect to the value and the possible abuses of these powerful rays, to say nothing of our uncertainty with regard to technical methods, it would seem that there is still further and very important work to be accomplished. More accurate standards are necessary and more careful studies on both operative and postmortem specimens are indicated. The careful collection of large series of data furnishes the only sure basis for fundamental advances.

During the short time in which I have been associated with the Mayo Clinic, most valuable co-operation has been established with the roentgen ray department under the direction of Dr. Carman, who has always proved a ready convert to the usefulness of reviews of postmortem studies. Not only are diagnoses compared and mistaken impressions corrected, but new processes are being investigated and further extensions are being planned. Routine roentgenograms of special regions of all dead bodies and careful comparison of these plates with those taken during life, on the one hand, and the actual lesions seen, on the other, will afford an incomparable method for educating our younger workers, carrying on special researches and perfecting the skill of both the clinical and laboratory members of our permanent staff.

Teamwork with the pathologist means so much mutual inspiration, such important advancement in the growth of our knowledge, and such honest acquirement of special skill and wisdom, that wherever possible, this form of cooperation should be undertaken to its fullest extent.

Bone Diseases: Non-Suppurating Osteomyelitis (Garre) Infectious Ossifying Periostitis (Bloodgood)

JOSEPH COLT BLOODGOOD, M. D.
Baltimore, Md.

IN the Journal of Radiology for March, 1920, page 147, in reporting two hundred and forty cases of bone tumors I discussed ossifying periostitis under the following classification:

1. Traumatic Ossifying Periostitis.
2. Syphilitic Ossifying Periostitis.
3. Pyogenic Ossifying Periostitis, associated with osteomyelitis.
4. Ossifying Periostitis about tuberculous lesions of bone.
5. Ossifying Periostitis associated with benign tumors near bone.

I should now like to correct type three and designate it *Infectious Ossifying Periostitis.*

In the two years since this publication the number of bone tumors has increased to almost nine hundred, and the number of cases of infectious ossifying periostitis from one to eight.

Recently Samuel Fosdick Jones, in the Journal of the American Medical Association (77:986, Sept. 24, 1921) in reporting a case somewhat similar to the one I discussed in the Journal of Radiology, called attention to the previous communication of Garre, who called the lesion *non-suppurative sclerosing osteomyelitis,* and gave the literature. I was not familiar with Garre's article until the appearance of the communication by Jones, but a few other cases had been observed and had been grouped together as a clinical, x-ray, and pathological entity under the group name of infectious ossifying periostitis.

That I have observed seven cases of this type since February, 1921, a period of thirteen months, is an indication that it is a bone lesion which we must bear in mind and one that must be differentiated from periosteal sarcoma when a single bone is involved, and from metastatic carcinoma when two or more bones are involved.

As this is but a preliminary report, I will not go into the details of a discussion of the literature, nor into any theoretical considerations, but simply record the most important factors in the history and in the x-ray picture. One must have a much larger group before one can be quite certain as to the etiological factors and the exact nature of this rare single or multiple and apparently primary periosteal bone lesion.

At the present moment this small group of single and multiple infectious ossifying periostitis shows a striking resemblance to infectious single or multiple arthritis.

We are all familiar with the so-called acute articular rheumatism, a polyarthritis of apparently infectious origin, which rarely, if ever, goes on to suppuration. In many instances there is complete recovery without loss of joint function; in other instances one or more joints are impaired by the unresolved inflammatory exudate. In a second group the primary attack may or may not be acute, but the arthritis of one or more joints persists with repeated exacerbations until there develops the clinical picture of arthritis deformans, which apparently is of two distinct forms: one, associated with bone formation, designated as osteoarthritis; the other without new bone formation, often called atrophic arthritis.

We now know that in all of these cases of infectious arthritis, whether one or more joints are involved, if we can find and remove the focus of infection, further attacks of arthritis do not occur, and the loss of function in the joint or joints remains as it was when the process was arrested, or improves.

It would appear that from a focus of infection we may have a single or multiple involvement of a bone, apparently chiefly a periostitis which does not go on to abscess formation so common in the pyogenic osteomyelitis in children, but may subside spontaneously as in acute articular rheumatism, leaving little or no evidence of the inflammatory process, or, it may persist as a thickening of the bone, or it may, if the focus of infection is not removed, go on to the typical picture of osteitis deformans first described years ago by Paget.

While arthritis deformans in adults is a common observation, Paget's osteitis deformans is rare.

PAGET'S OSTEITIS DEFORMANS

I have a record of but a single case (Pathol., No. 21812-1/2, J.C.B. 5067). This patient was observed in July, 1913, and remains in the same condition in March, 1922—nearly eight years. The lesion involved the tibia and showed the bowing and increased thickening of the cortical layer as described by Paget. The patient was a white male, aged fifty-eight, and the ossifying periostitis of the tibia developed gradually after a contusion. It was of two years duration when I first saw the patient. The Wassermann was negative, antiluetic treatment had no effect; no search was made for foci of infection. The patient still suffers from

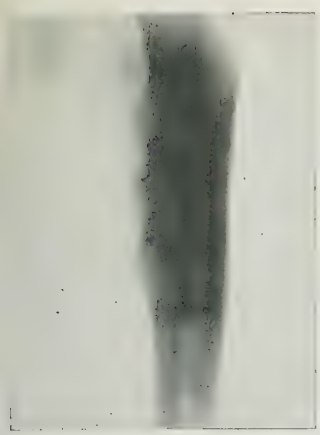


Figure I.—Case I.—Pathol. No. 16865. Infectious ossifying periostitis of shaft of left femur. Focus of infection carbuncle on thigh. Diagnosed periosteal sarcoma in 1914. Refused amputation. Well in 1922.

pain and disability; the size of the tibia has gradually increased; the bowing has increased. This man has received no treatment, and no further investigation since I saw him in 1913.

A Typical Case of Infectious Ossifying Periostitis of the Garre Type Involving a Single Bone.

Case 1—(Pathol., No. 16865, J.C.B., 5617)—Olaf Swanson. This patient's case was reported in detail in the Journal of Radiology, March, 1920, p. 205 (Figs. 81 and 82, p. 235). The observation is of added interest, because, clinically, from the x-ray and microscopically from a piece excised for diagnosis, it was diagnosed by many as *periosteal sarcoma* of the shaft of the upper third of the femur. The patient, however, refused amputation, or any treatment, and is now well and capable of hard work in March, 1922, eight years after he was first observed by me.

The etiological factor was a boil on the medial side of the lower third of the thigh, the side on which the femur became involved. This boil had been first observed about five months before I saw the patient and had healed in two weeks. Following the healing of the boil the patient was conscious of pain and swelling involving the upper third of the shaft of the femur, and he entered my clinic at St. Agnes Hospital in 1914 because of this pain and this swelling.

I have gone over all of the cases of sarcoma of bone and in not one is there a history of a local infection of this kind on the limb preceding the development of the periosteal sarcoma.

Figure II—Case I.—Pathol. No. 16865. Infectious ossifying periostitis. See Figure I.

The patient could walk without limp. No other lesion, except that involving the upper end of the femur could be made out. All laboratory examinations, except the x-ray, were negative. Nothing could be seen on inspection. Palpation revealed a spindle swelling surrounding the shaft of the upper end of the femur beginning at the great trochanter and most marked on the medial side. This spindle swelling was much larger than the area of bone formation shown in the x-ray (Figs. 1 and 2).

When we have a spindle swelling of a long pipe bone, which does palpate like bone and which cannot be explained by the shadow of bone formation in the x-ray, it is very suggestive of periosteal sarcoma. But, as pointed out in the Journal of Radiology in March, 1920, such spindle swellings have been observed in syphilitic ossifying periostitis and this type of infectious ossifying periostitis; but, in my experience, not in traumatic ossifying periostitis, at least, in the later stages of the disease.

X-rays. (Figs. 1 and 2). These were interpreted in 1914 as periosteal sarcoma, and they have been shown to many colleagues since who made the same diagnosis, but recently in Chicago when I threw the lantern slide on the screen and requested opinion from the roentgenologists in the audience, two made the correct diagnosis of either syphilitic or infectious ossifying periostitis. In these pictures the outer zone of bone has the hazy, cloudy appearance common in periosteal sarcoma, but the next irregular zone of bone resting on the cortical layer is of a density unusual in sarcoma. Nevertheless, I have cases of proved periosteal sarcoma in which this dense layer of

Figure III—Case I.—Pathol. No. 16865. Infectious ossifying periostitis. Result two years after Figures I. and II.

periosteal bone is present. In this case under discussion the cortical bone showed areas of destruction, but this may be observed in syphilitic periostitis, and we now know, it may be present in infectious periostitis. The shadow of the marrow cavity is much more distinct than is usual in sarcoma, because in periosteal sarcoma there is rapid involvement of the shaft beneath by infiltration through the Haversian system, and this infiltration produces definite reactions in the cancellous bone and marrow cavity, and changes the entire architecture of the area of involved bone, and this change shows distinctly in the x-ray. See the Journal, March, 1920, p. 229 (Figs. 62, 63 and 64).

The patient left my clinic at St. Agnes, because amputation was suggested, and entered another hospital, where a piece was excised for diagnosis. The operator found, first, a fairly distinct capsule, a zone of tissue containing no bone, and then a zone of tissue containing new bone.

Microscopic Picture. Fig. 4 (low power) shows the two zones—one with bone and one without. Fig. 5 is a high power photomicrograph of the very cellular tissue. These sections were then interpreted, and frequently since, as sarcoma.

Result. Fig. 3 is an x-ray about two years after the exploratory incision. A recent x-ray, eight years after observation, has not yet been made.

Remarks. I believe this observation corresponds to the cases described by Garre as non-suppurating sclerosing osteomyelitis, and the case recently described by Jones.

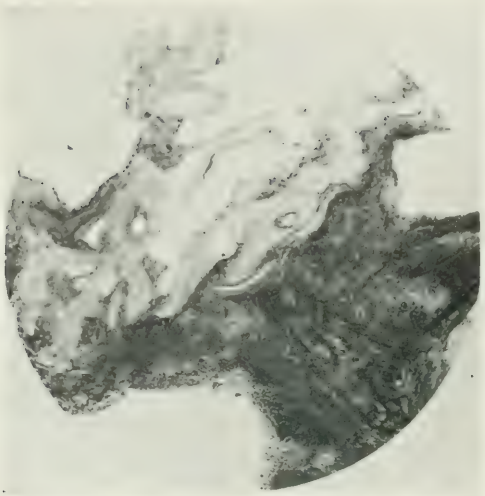


Figure IV.—Case I.—Pathol. No. 16865. Microscopic picture (low power) from piece excised for diagnosis.

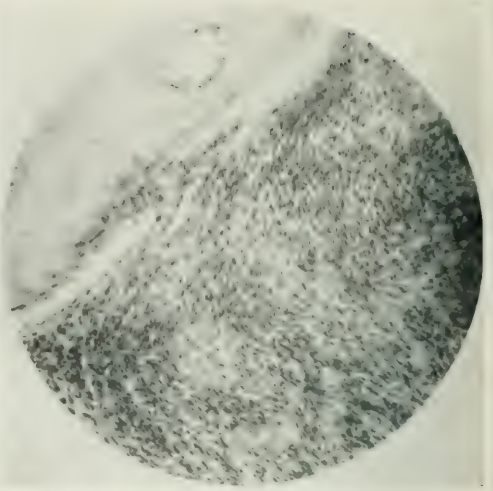


Figure V.—Case I.—Pathol. No. 16865. Microscopic picture (high power) from piece excised for diagnosis.

Complete resolution took place in the case observed by me, because the focus of infection (the carbuncle) healed spontaneously. If it had not healed, it is possible that the lesion in this individual would have continued and developed the picture of osteitis deformans of the femur as described by Paget, similar to the first case involving the tibia, reported here.

OTHER CASES OF INFECTIOUS OSSIFYING PERIOSTITIS OF THE GARRE TYPE INVOLVING A SINGLE BONE. . . . . .

Case 2—(Pathol., No. 28771, J.C.B., 10894)—This case was first observed in September, 1921. The patient, J.E.D., was referred to me by Dr. Walter A. Ostendorf, of San Antonio, Texas.

The x-rays showed that the upper end of the femur, trochanter and neck, is involved. Fig. 6 illustrates an ossifying periostitis which almost excludes sarcoma. The new periosteal bone involving the shaft suggests an old affair. About the neck above and below there are dark areas suggesting new bone formation or calcification, as I have seen frequently in tuberculosis. There is also an area of new bone formation from the pelvis just above the rim of the acetabulum. The x-ray picture suggested to me a lesion of long duration—either syphilis, tuberculosis, or infectious ossifying periostitis. Fig. 7 is another view. The bone formation here on the shaft is not unlike periosteal sarcoma, but the marrow shadow is against sarcoma.

Periosteal sarcoma in this region of the femur involving the neck is very rare. I have pictured a typical case in the Journal of Radiology, March, 1920, p. 230 (Figs. 65 and 66).

Clinical History. Although the x-ray suggested a bone lesion of many months duration, there have been no symptoms except for three months, and the symptom of onset was unusual. While swimming, this patient kicked out, experienced a sudden pain in the left hip which lasted for ten minutes; the hip was sore for three days. One month later, on stepping out of an automobile, the sudden pain in the hip was so intense that he fainted, but later was able to get into the automobile. There was residual soreness for two days. Then the patient began to limp and used a cane, mostly because of the fear of another attack of this pain. One month and again four days before I examined him, there had been a short, acute attack of pain of less intensity. The patient had never been conscious of any restriction of motion, nor has he ever felt a swelling.

Examination. Nothing could be seen on inspection. On palpation in the region of the upper third and trochanter, the bone seemed thicker and rougher. There was practically no restriction of motion and very little tenderness. All laboratory examinations were negative, except for pus in the urine and a slight urethral discharge in which no gonococci could be found. X-rays of other bones, teeth and sinuses negative.

Etiological Factor. The patient gives a history of repeated attacks of gonorrhea without complications between fifteen years and two months ago. In one attack he remembers pain in the shoulder. The patient, therefore, has had a gonorrheal infection for many years.

He was given, as a matter of precaution, intravenous salvarsan and local treatment for the urethral discharge until it disappeared.

Remarks. We know that gonorrhea may produce a single or multiple arthritis even up to complete joint destruction, and I have observed fully developed and typical polyarthritis deformans from gonorrheal infection. In a few instances I have observed a gonorrheal arthritis extend to the neighboring bone and produce typical osteomyelitis. In this instance, apparently, a gonorrheal infection had given rise to an ossifying periostitis of such an insidious character that there were no symptoms until three months before the x-rays were taken. The clinical picture was that of a "snapping" or locking hip and could be easily explained by some motion in the hip-joint beyond the usual degree which impinged upon an area of new bone formation.

Result. (March, 1922, six months since observation). As the patient has walked with a cane and has avoided all extreme motions in the hip, there have been no further attacks of pain, but he is conscious of discomfort. A recent x-ray has been taken, but has not yet been received here.

I have reviewed all my cases of gonorrhoeal infection of joints and bones of which I have x-rays—some fifty cases in all—and find nothing identical with this. I do find ossifying

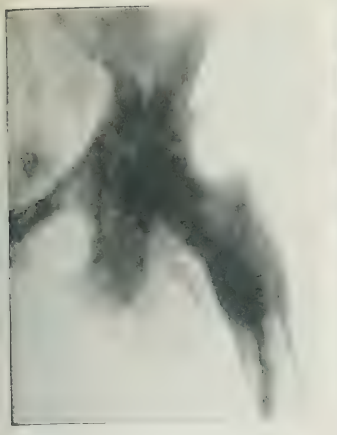


Figure VI.—Case II.—Pathol. No. 28771. Infectious ossifying periostitis associated with gonorrhoea.

periostitis in conjunction with gonorrhoeal arthritis, but none with an uninvolved joint as in this instance.

Case 3—(Pathol., No. 29084, J.C.B. 10978). First observed October 29, 1921. This patient. Dr. L.A.W., was not seen by me, but his history and x-ray were referred to me by Dr. Walter A. Calihan of Rochester, N. Y. It is an infectious ossifying periostitis of the upper shaft of the femur not involving the neck, and apparently due to foci of the infection in the teeth. Fig. 8 is the x-ray. As compared with Fig. 6 it shows chiefly thickening of the cortical bone beginning at both trochanters and extending down the shaft. This thickening shows both, dark and light areas. The marrow shadow is but slightly changed. There is no marked evidence of recent bone formation. It suggests an old affair.

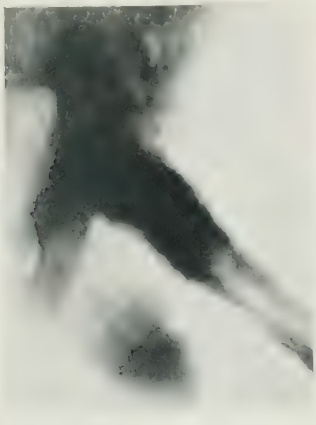


Figure VII.—Case II.—Pathol. No. 28771. Infectious ossifying periostitis associated with gonorrhoea.

Clinical History. The patient is a white male, aged fifty-six. He has had lumbago for years. Three months before the x-rays were taken, he began to have pain in the left knee and thigh, worse at night. This has continued since.

Examination. The x-rays of the teeth show infected root abscesses, the tonsils are infected; the blood pressure is 110-80; other laboratory examinations negative. Dr. Calihan and his colleagues were rather of the opinion that it was not sarcoma, but chronic osteomyelitis. No note was sent to me on the palpation of the involved area of the femur, nor on joint motion. I concurred in their diagnosis and advised extraction of the teeth and removal of the tonsils.

Case 4—(Pathol. No. 29153, J.C.B. 11058)—This patient's history (Miss J. B.) and x-ray were referred

Figure VIII—Case III—Pathol. No. 29084. Infectious ossifying periostitis associated with root abscesses of teeth.

to me by Dr. E. L. Kiesel of Scranton, Pa., in November, 1921. The ossifying periostitis involved the upper third of the shaft of the femur, and suggests the healing or healed stage.

X-ray—(Fig. 9)—This practically describes itself. One would not think of periosteal sarcoma. The x-ray picture could easily represent the healed stage of traumatic, syphilitic or infectious ossifying periostitis. The thickening is chiefly on the medial side; the shadow over the marrow cavity is undoubtedly due to cortical thickening and not marrow involvement. It is not the picture observed in sarcoma.

Clinical History—The patient is a white female, aged seventeen, and has complained for one year of pain in the left hip and thigh. The pain is worse at night and relieved by aspirin. The patient is at work as a bookkeeper. There has been no fever or loss of weight. The Wassermann is negative, the blood shows slight anemia with a leukocyte count of 5,600. There is no history or evidence of a gonorrheal infection. The x-ray of the chest shows that the excursions of the diaphragm are diminished with a slight shadow in the peribronchial

Figure IX.—Case IV.—Pathol. No. 29153. Infectious ossifying periostitis, healed, in quiescent stage. Foci of infection not ascertained.

Figure X.—Case V.—Pathol. No. 29391. Infectious ossifying periostitis. in healed stage. Focus of infection in finger.

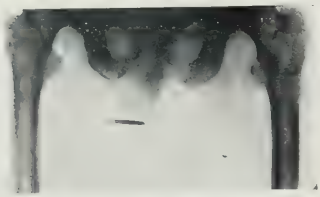


Figure XI—Case VI—Pathol. No. 29019. Multiple infectious ossifying periostitis of femur and tibia. Focus of infection in colon (?). See Figure XII.

Figure XI.-a—Case VI.—Pathol. No. 29019. Multiple infectious ossifying periostitis of femur and tibia. X-ray taken four months after that shown in Figure XI.

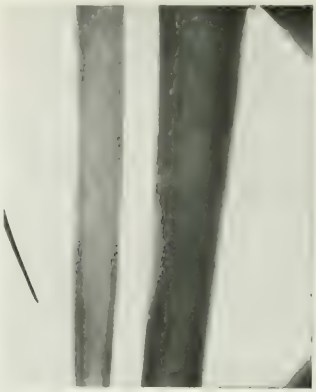


Figure XII.—Case VI.—Pathol. No. 29019. Multiple infectious ossifying periostitis. Focus of infection in colon (?). See Figure XI.

Figure XII.-a—Case VI.—Pathol. No. 29019. Multiple infectious ossifying periostitis of femur and tibia. X-ray taken four months after that shown in Figure XII.

region in the middle of the hilus of the left lung.

There is no evidence of an infection of the nose and throat, nor of the teeth. The patient remembers a bump on this thigh a month before the pain began.

Result. March, 1922, four months. Dr. Kiesel sent me a second x-ray, which is practically identical with the first (Fig. 9). There is no evidence of any new periosteal bone formation or bone destruction. The patient is just recovering from an attack of bronchopneumonia.

Remarks. This may be an example of traumatic ossifying periostitis, but I am suspicious of a focus of infection somewhere, perhaps in the lungs, on account of the x-ray picture, the low leukocyte count, the slight anemia, and the recent bronchopneumonia. It resembles, in the x-rays, closely the cases reported by Garre and Jones. It is not unlike the x-ray studies of Paget's disease, except there is no bowing, and the amount of bone formation is moderate.

Dr. Kiesel reports later that the area shown in the x-ray is palpable. He is inclined to the opinion that it is not sarcoma.

Case 5—(Pathol. No. 29391. J.C.B. 11295). The history and x-rays in this case were sent to me in December, 1921, by Dr. H. H. Sherk of Pasadena, California. The lesion involves the shaft of the femur and suggests the healed stage of infectious ossifying periostitis. Dr. Sherk and his colleagues were of the opinion that it was not sarcoma. The x-ray (Fig. 10) was taken November 23, 1921, and does not differ from previous x-rays.

Clinical History. White female, aged forty-eight, unmarried. There is a long history of ill health, of an attack of bronchopneumonia, of gastric symptoms, of scarlet fever, of a chronic skin lesion, of a chronic infection of one finger and of infected teeth. The first x-ray of the femur was taken in 1919 and showed the lesion of the shaft of the femur about as it is in 1921. The patient still has pain in the involved finger which has healed, but the x-ray of the hand shows nothing definite.

MULTIPLE INFECTIOUS OSSIFYING PERIOSTITIS.

Case 6—(Pathol. No. 29019, J.C.B. 10950). First observed in October, 1921. Two small lesions, one in the upper shaft of the femur and one in the shaft of the tibia. Etiological factor not discovered after complete examination.

This patient (F.D.K.) a white male aged sixty-seven, was referred to me by E. F. Root of Salt Lake City. Fig. 11, an x-ray taken October 12, 1921,

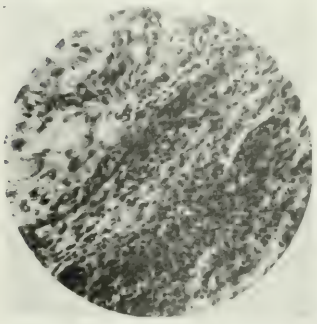


Figure XIII.—Case VI.—Pathol. No. 29019. Multiple infectious ossifying periostitis. Focus of infection in colon (?). Microscopic picture of piece excised from focus in tibia, interpreted as granulation tissue.

Figure XIV —Case VII.—Pathol. No. 29616. Multiple infectious ossifying periostitis of both bones of both legs and pelvis, most marked on right tibia.

Figure XV.—Case VII.—Pathol. No. 29616. Multiple infectious ossifying periostitis of both bones of both legs and pelvis, most marked on the right tibia.

shows the small lesion on the outer side of the shaft of the femur below the trochanter. There is periosteal bone formation with some cortical destruction and not much change in the marrow cavity. In this area, although there was pain and tenderness, little or nothing could be made out on palpation. Fig. 12, an x-ray taken on the same date, shows a small lesion in the middle third of the shaft of the tibia on the fibula side. Here also there is some periosteal bone formation and cortical destruction, but the marrow shadow is normal.

I have never observed primary periosteal sarcoma to occur as a multiple lesion, nor have I ever observed metastatic bone tumors to appear as periosteal lesions. Therefore, the x-rays in this case suggested that the lesion was of an inflammatory type, traumatic, syphilitic, or what I have called infectious ossifying periostitis. In this case repeated Wassermanns were negative and intravenous salvarsan was followed by no improvement.

The onset of the illness began three months before I saw the patient, acutely and without a history of previous illnesses which could be looked upon as etiological factors. This man, in apparently good health, experienced fatigue, weakness, difficulty in using his lower limbs, but no pain. Dr. Root who made a careful examination found albumin and casts in the urine, and there was occult blood in the stools. The patient gradually improved and then began to have pain in the upper third of the right femur and in the middle of the left tibia with some swelling of the left foot when he walked; sleep was disturbed by numbness and discomfort in the lower limbs. X-rays were taken and a provisional diagnosis of sarcoma of the right femur and left tibia suggested.

The patient came under my observation three months after onset, complaining chiefly of pain in the two bone foci. We were unable to get a history of trauma or of any infectious disease. A most thorough and repeated examination was made—everything was negative except blood in the stool which was intermittent. A rectal examination found a few external hemorrhoids, and, on proctoscopic examination, we found one small polypoid mass the size of a split pea which could explain the little blood in the stool. Systematically nose and throat, tonsils, teeth, prostate, seminal vesicles were examined without positive findings. X-ray studies with bismuth were made of the colon with negative results. There was nothing in the clinical history to suggest a lesion of the colon beyond the small polypoid mass found on the proctoscopic examination. On palpating the two bones in the area of the femur nothing definite was made out, while in the area of the tibia there was infiltration of the tissues on the fibular side.

Dr. Root wrote me that the symptom of onset suggested acute nephritis and later the bone foci became clinically evident by pain and tenderness. X-rays of other bones were negative.

This was my first observation of a lesion of this kind.

Operation. October 15, 1921. Under novocaine I explored the focus in the tibia. The periosteum was a little thickened by inflammatory tissue; there was little new bone formation and some bone destruction of the cortical layer.

The *microscopic picture* (Fig. 13) was interpreted as inflammation and not sarcoma.

Result. March 22, 1922, five months, Dr. Root writes that the patient looks well and is able to attend to business. He walks on crutches, because the right hip is swollen and painful. This swelling has taken place since he passed from my observation. The wound on the left tibia, which had healed when he left St. Agnes Hospital, broke down, discharged for a short time and healed. This is evidence in favor of an inflammatory lesion and against sarcoma. The patient still observes a little blood in the stool. The urine, however, shows no evidence of albumin or casts. The red and white blood count was normal; the hemoglobin is a little low—sixty-eight per cent; while under my observation it was eighty per cent.

X-rays were taken January 23 and February 13. On January 23 the lesion of the femur as compared with Fig. 12 shows some smoothing down of the irregular periosteal bone formation, but slight increase in the cortical destruction, while the later x-ray of the same area on February 13, shows an increase of the periosteal bone formation and a beginning involvement of the trochanter above with a new focus in the tuberosity of the ischium.

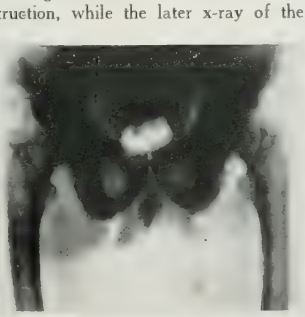


Figure XVI.—Case VII.—Pathol. No. 29616. Multiple infectious ossifying periostitis of both bones of both legs and pelvis, most marked on the right tibia.

The changes in the tibia as compared with Fig. 13 on January 23 showed perhaps a slight increase in bone destruction and bone formation, while on February 13th cortical bone destruction had almost reached the marrow cavity. The patient still complained of pain.

Remarks. Apparently in this patient there is no great improvement in the bone lesion, and a third focus has appeared, but it is to be noted that the focus of infection has not yet been found.

I have just been sent the x-rays taken February 19, 1922. Fig. 11-a should be compared with Fig. 11. The difference in time is four months. The lesion below the greater trochanter shows more bone formation; the marrow cavity is not invaded; beneath the new periosteal bone the cortical layer shows destruction. Note the new bone focus on the ischium.

Fig. 12-a should be compared with Fig. 12, four months difference in time. My impression is that the lesion on the tibia which I explored is healing. The new bone is more condensed, the cortical layer has been almost completely restored; the marrow cavity is not involved.

MULTIPLE INFECTIOUS OSSIFYING PERIOSTITIS.

Case 7—(Pathol. No. 29616. J.C.B. 11452)—This patient (W.J.C.) came under my observation February 11, 1922, with E. W. Grier of Elizabeth, N. J., who had carefully studied the case. His chief complaint was pain and swelling of the upper third of the right leg. The swelling disappears after rest in bed. The pain keeps him awake at night. He walks without a limp. On palpation there is thickening of the upper half of the right tibia with distinct bowing. X-ray studies, however, found involvement of both bones of both legs and the pelvis.

X-ray Studies. Fig. 14, a lateral view, shows that the right tibia is bowed and there is thickening of the cortical layer. This is the picture usually seen in syphilitic periostitis or in the early stage of Paget's disease. It is not unlike the x-rays reproduced by Jones Yet, this picture shows that the fibula on the same side, and both bones of the other leg, show here and there new bone formation and definite thickening of the cortical layer without change in the marrow shadow. Fig. 15 is an anteroposterior view of the bones of the leg and shows changes similar to those in

Fig. 14. Fig. 16 demonstrates that the femora are uninvolved, but there is distinct evidence of an ossifying periostitis of the pelvis, chiefly of the ischium and the pubic bones. No other bones showed evidence of involvement. Palpation was negative except for the thickening and bowing of the right tibia.

Clinical History. This patient, aged sixty-four, was apparently well until November, 1921, two and one-half months ago. He was taken with a sudden collapse. Dr. Grier found him in bed, the heart action was rapid and irregular, but there was no fever and no other definite symptoms. From this attack there was apparent recovery and he returned to work. Then, in a few weeks, he observed pain in the right tibia. The pain was intermittent and radiated to the ankle. Then he observed swelling of the edematous type which disappeared after rest in bed. Then there was slight bowing of the tibia and on examination increase in the thickness of the upper third of the shaft of the tibia.

Examination. Wassermann negative. Blood practically normal. Urine contains a trace of albumin. Slight increase of blood urea and blood sugar. A faint systolic heart murmur geared at the apex and transmitted to the axilla. No enlargement of the heart on percussion or in the x-ray. Teeth show evidence of root abscesses. Tonsils infected; nasal septum deflected to the right; sinuses cloudy.

The patient returned home, was given salvarsan without relief, and some of the teeth were extracted.

Second Examination. February 11, 1922. No change. Swelling of the right leg disappears after rest in bed. Pain is better when he remains quiet. No fever, no leukocytosis. X-ray shows no change in the bones of the leg. Apparent improvement in the pelvic bones. General condition good. Dr. Grier was advised to have the affected teeth extracted, the tonsils removed, the deflected septum repaired and the sinuses drained.

Remarks. These two cases of multiple infectious ossifying periostitis are not unlike multiple osteomyelitis in children, except the lesions have not gone on to suppuration. In both there is a history of an acute attack, however, without fever or leukocytosis; in one cardiac symptoms predominated, in the other there were signs of nephritis.

INFECTIOUS OSSIFYING PERIOSTITIS OF THE BONES OF THE SKULL.

Case 8—(Pathol. No. 29831, J.C.B. 11021. This patient (Mrs. C.T.) was brought under my observation by Dr. S. Ginsberg of New York, with a complete history and a most thorough examination March 25, 1922.

The most striking feature is the involvement of the entire bones of the skull with no apparent involvement of the bones of the face or skeleton, and multiple root abscesses. Since the recent extraction of many of the infected teeth, there has begun to be improvement.

X-ray Studies. Fig. 17 and Fig. 18 show an antero-posterior and a lateral view of the skull. The predominant picture is ossifying periostitis of the external table, thickening of the skull bone with possibly a small exostosis on the inner table of the occipital bone; the facial bones are not involved; the sinuses are free; the remaining teeth show no positive evidence of root abscess.

I have a number of cases of primary sarcoma and metastatic carcinoma of the bones of the skull—none give this diffuse picture.

Clinical History. This is against malignant disease, because the first bone growth was found five years ago. For one year previous to this there had been pain in the teeth. The patient also gives a history of acute polyarthritis twenty-five years ago with recurrent mild attacks since. The second bone enlargement appeared three years after the first. Then nodules appeared rapidly, the last ten days ago. With the appearance of a bone nodule on the skull, there followed quickly over it tenderness and edema. This has been observed by the patient and her physician. The tenderness and edema disappear leaving the irregular thickening on the surface of the skull. The patient thinks some of the bony nodules have disappeared. Dr. Ginsberg has observed them to become smaller, but never to disappear. With the appearance of the tenderness and edema there is sometimes fever and a leukocytosis of 15,000 and a polymorphous leukocytosis of eighty-two per cent. There

Figure XVII.—Case VIII.—Pathol. No. 29831. Infectious ossifying periostitis of bones of the skull. Focus of infection root abscesses of teeth.

Figure XVIII.—Case VIII.—Pathol. No. 29831. Infectious ossifying periostitis of bones of the skull. Focus of infection root abscesses of the teeth.

have also been intermittent attacks of edema of the eyelid, the first two years ago, the last two weeks ago; headaches have been a prominent feature for two years without nausea or vomiting. Eight months ago there was blurring of vision with choke disk which gradually disappeared. A recent complete neurological examination is negative. A nodule appeared some months ago on the rib and disappeared.

In spite of a negative Wassermann one year ago, antiluetic treatment was pushed to the limit without help.

Every possible examination has been made, thoroughly and repeatedly. The positive findings are the changes in the skull and the abscesses of the teeth which have now been extracted.

I advised Dr. Ginsberg to have all the remaining teeth extracted, and then to consider the question of removal of both tonsils, which are buried and suggest slight infection, although there is no history of tonsillitis.

Conclusions

I am now restudying all of my old and recent observations of osteomyelitis of all types and of ossifying periostitis.

This is but a preliminary report with the hope that it will stimulate a search for bone lesions of this type. For the present no conclusions should be made.

Apparently there is a definite type of non-suppurating ossifying periostitis or sclerosing osteomyelitis. I have sufficient cases to demonstrate that trauma and syphilis may produce it. It is observed as a post-typhoid and post-influenza lesion, and apparently it may be secondary to any type of infection.

As a single lesion in the early stage it will present difficulties in differentiating it from periosteal sarcoma. When it is multiple, sarcoma can be excluded. The x-ray picture, as far as my experience goes differentiates it from multiple ostitis fibrosa and metastatic carcinoma.

The most important points in treatment are the administration of salvarsan intravenously and a search for the focus of infection, which, when found should be removed. I have no evidence as yet that incision with removal of the new bone formation is helpful.

The Value of Imbedding Radium in the Treatment of Carcinoma of the Breast*

RUSSELL H. BOGGS, M.D.
Pittsburgh, Pa.

TREATING carcinoma of the breast by imbedding radium throughout the gland and adjacent glandular tissue, supplemented by surface applications of radium and heavy filtered x-ray, makes radiation as thorough as amputation in both early and late cases. After such radiation, removal of the fibrous portion of the breast may be indicated, but a radical operation is seldom ever necessary.

The reason for advocating radium by the method described is that early cases can be clinically cured without opening the lymphatic channels and if operation is indicated later, it is performed when the cancer cells are nearly all destroyed, that is when cell proliferation is checked and only latent cancer cells are removed. In many cases at least imbedding radium takes the place of operation, but until we have more data, it may be advisable to operate between four and six weeks after primary radiation, when cancer cells are sickened, as William J. Mayo expresses it. In late cases radiation as just described is superior to any form of an operation primarily, and in these cases if the breast is removed, at least the axilla should scarcely, if ever, be opened following radiation. At present probably the safest method to follow is to give sufficient surface treatment of radium or x-ray and then two or three weeks later to imbed radium throughout the breast, into the glands of the axilla and into the glands leading from the axilla to the breast, and then four weeks later to remove the breast and as much of the adjacent

*—Read at the Annual Meeting of The Radiological Society of North America, Chicago, Dec. 7, 1921.

Figure I.—Inoperable carcinoma of the breast, thirty-seven needles inserted into the breast and adjacent tissues for five hours, two months after surface application of x-ray and radium had been given.

Figure II.—Roentgenogram of the same case, showing the needles imbedded in the tissues.

tissue as is deemed necessary. If the removal is done at this time, it will be done before much fibrous tissue has formed.

In all the progress made in recent years in radiotherapy, nothing has been evolved of such significant import in the treatment of carcinoma of the breast, as the advanced method of imbedding radium, with its manifold and varied advantages and possibilities in deep therapy. By imbedding radium throughout the entire breast, in the axilla, into the glands leading from the breast to the axilla and into the glands below the clavicle, this supplemented by deep x-ray therapy, radiation is made as thorough as a radical dissection without opening the lymph channels.

In the early days of radiotherapy a deep lethal dose could not be given without producing superficial ulceration or necrosis. By imbedding radium a lethal dose can be given without any effect on the skin. Besides the subcutaneous tissue will tolerate from three to five times as much radiation as the skin. The result of radium in malignancy depends upon whether a lethal dose is given. Formerly it was concluded, because our best radiograms were taken with comparatively low tubes, that this form of radiant energy was the most suitable for deep therapy. Almost every one overlooked the loss of energy by absorption in the tissues and by divergence of the rays, and practically nothing was known about the lethal dose of different types of malignant cells. Most radiologists compared everything with the amount

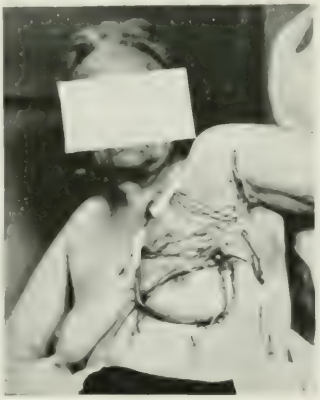


Figure III.—Advanced carcinoma of the breast with marked axillary involvement. Thirty-six radium needles inserted for six hours. Disease in the glands and the breast has entirely retrogressed and the patient is clinically cured.

of radiant energy necessary to destroy rodent ulcer; and when the squamous cell epithelioma, axillary nodes and a cancerous mass in the breast did not disappear under x-ray, the radiation was considered useless. The real fact was that a lethal dose had not been given.

Radiation for the treatament of carcinoma of the breast has been so changed by imbedding radium that where only superficial skin effects were formerly produced, now cancerous tissue deeper than that which can be removed by the knife can be destroyed without opening the lymphatic chains.

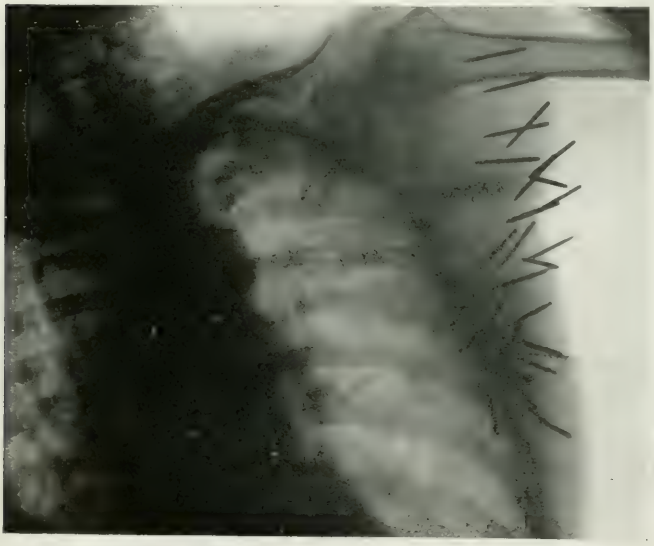


Figure IV.—Roentgenogram of Figure III., showing the needles in position.

Before imbedding radium I always give surface applications in the axilla and over the glands below the clavicle, and I give a complete course of heavy filtered x-ray treatment to the breast and all the glands draining it. This checks cell proliferation and lessens the danger of metastases when the breast and adjacent lymphatics are speared and radium inserted. It is generally agreed that it requires from two to four weeks to check cell proliferation. It has been shown that the lymphatics begin to undergo a fibrosis at the end of the fourth week and that the caliber of the lymphatic vessels is smaller than before treatment was given. It seems just as advisable to give surface treatment before imbedding radium as before operation. Some few surgeons are now advising ante-operative treatment, and if they would include imbedding radium and remove less tissue, thereby leaving the sclerosed lymphatic tissue as a barrier against cancer cells I feel sure that the end results would be better, at least in borderline cases; that is, there would be fewer recurrences, and if a recurrence did take place it would be considerably later than when the operation precedes radiation.

Imbedding radium in the treatment of carcinoma of the breast is a step in advance, but the number of cases treated by this method are not sufficient and its use is of too short duration to speak about anything but temporary results. Even in some of the advanced cases the disease in the breast and the glands appears to have retrogressed, clinically. Not enough cases have been operated upon to give definite histological changes.

A study of the lymphatic and bone metastases will show that although the case is operated upon early, raying as usually given in the past, that is, raying the line of incision, axilla and supraclavicular region, is very incomplete because there are twenty or more chains which drain the breast. The most important of these which metastasize beside the axillary and supraclavicular are the suprascapular, anterior pectoral, internal mammary, subscapular, paravertebral, xiphoid, and inguinal groups.

According to Handley, the frequent involvement of the liver is attributed to the cancerous dissemination along the deep lymphatics of the fascia of the thoracic wall to the epigastrium and to the umbilicus, whence these cells follow the subserous lymphatics to become deposited either on the surface of the liver or are conveyed along the lymphatics of the falciform ligament to the portal glands. If Handley's deductions are correct, we should never omit heavy treatment over the epigastric region. Next in frequency are the lungs and

pleurae, which are supposed to become involved through the intercostal or supraclavicular lymphatics.

Many consider a three year limit as a cure of cancer of the breast, but we cannot be sure that recurrences will not take place later. Barker has stated that thirty per cent of the cases that are clinically cured at the end of three years, later die of cancer of the breast. Since operation has about reached its limits and since ultra-radical operations are not practical until some better form of treatment is discovered, the splendid results achieved from radiation furnish more than sufficient reasons for giving every case of carcinoma of the breast efficient radiation. This should be done even if the tumor is small, because even in such cases there may be early and fatal metastases. Handley says that the pelvic viscera are involved in 8.6 per cent of early cases in young patients and in 4.8 per cent of the older patients.

It has been proved that four out of five patients in whom carcinoma is confined to the breast, as proved by microscopic examination of the tissues adjacent to this organ, are cured by radical operation. When axillary lymph nodes are found to contain cancer microscopically, the patient has only one chance out of five of being cured by operation. This deduction is practically the same as that of Halstead, who says that notwithstanding the present day extensive operation, death from metastases occurred in 23.4 per cent, even in cases with a microscopic negative axilla. It is being generally conceded by the surgeons that there is more palliation received from radiation in inoperable cases than that which is accomplished by any other method. At present there is a growing general dissatisfaction with operation of a palliative nature in the treatment of carcinoma of the breast. An incomplete operation never checks the progress of carcinoma, but on the other hand usually hastens death both in the early and late cases.

The prognosis and treatment of mammary carcinoma can be estimated only after careful consideration of many factors. Nearly all surgeons consider operation contra-indicated when there is extensive ulceration, when the tumor is adherent to the chest wall; when the axillary nodes are fixed; when there is supraclavicular involvement; and when there is indication of distant metastases. When the axillary glands are palpable there are very few cures from surgery alone without radiation, even when the axillary nodes are not palpable, and when the glands are found to contain cancer cells microscopically only about twenty per

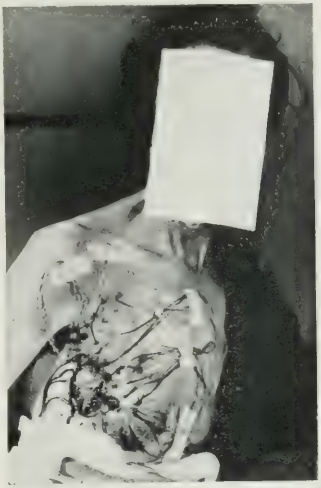


Figure V.—Inoperable carcinoma of the right breast. Thirty-two radium needles inserted into the breast and adjacent tissue for six hours. Surface application of radium and the x-ray, which preceded imbedding the radium, greatly reduced the mass in the breast.

cent of the cases are cured at the end of five years.

Greenough claims that when the axillary nodes are palpable, 12 per cent were cured by operation, and Finsterer stated 4.3 per cent. The latter represents the average success of surgery, which means that a woman who has a well established cancer of the breast, with palpable axillary nodes, has one chance in twenty-five of being cured by operation. Therefore, in cases of this class it is not too much to advise imbedding radium and giving a thorough course of radiation before the removal of the breast.

In conclusion, even in some of the advanced cases the disease in the breast and in the glands has clinically retrogressed by imbedding radium. Of course in some cases there is still thickening due to the fibrosis from the radiation. In the inoperable cases usually we were inclined to leave well enough alone, and in the early cases each one has refused operation. My advice has been, even in the advanced cases where the disease has clinically receded, to have the breast removed after extensive radiation without opening the axilla, but to my extreme disappointment, in almost every case that I have turned over to the surgeon, the axilla was opened and when the patient returned, in nearly every instance she would have a swollen arm and was in much worse condition than before operation. I feel sure, however, that if we could have the surgeon remove only the breast, thereby taking away the unhealthy mammary gland, the patient would be greatly benefited. I am speaking of the advanced or inoperable cases which have had thorough radiation, and not the early cases which we are advising to have ante-operative radiation.

Successful treatment in carcinoma of the breast can be attained only by the total eradication or degeneration of all cancer cells present throughout the body, whether the method selected is surgical or radiological.

Figure VI.—Roentgenogram of Figure V., showing the needles imbedded throughout the breast and surrounding tissues.

An Effect of X-Ray on the Germ Cells*

JAMES W. MAVOR, Ph. D.
Schenectady, N. Y.

The experimental work here to be described was undertaken at the suggestion of and with the assistance of the Research Laboratory of the General Electric Company. The experiments have been carried out at the Biological Laboratory of Union College. The first object has been to search for a specific effect of x-rays on the dividing cell. A second problem which has grown out of the first has been the modification of the germ cells by external means.

The egg cells are actively growing cells which continue their growth in the ovary of the adult. Since we know in great detail the method of division and the different phases through which primitive egg cells pass as they become mature eggs, these provide a ready and convenient means of testing the effect of x-rays on dividing cells. Further, since these cells after fertilization give rise to new individuals, we have a means of testing for slight effects which might not otherwise be noticed. In our experiments we have investigated the effect of x-rays on the egg cells of a small fruit fly and compared them with their effect on the adult tissue.

The understanding of these experiments demands a certain knowledge of the life cycle of the fruit fly and of Mendelian inheritance. Like all other flies, the fruit fly hatches from a small egg as a larva or grub. This larva feeds on the yeast which grows on fermenting bananas. After feeding for four or five days the larva crawls out of the banana and forms a pupa. In this pupa the larva metamorphoses into an adult fly which emerges about four days after the pupa is formed. This fly is soon able to lay eggs. So that the complete cycle takes from nine to ten days. The flies are easily reared in bottles, and a single pair placed in a bottle containing a ripe banana will give from two to three or more hundred offspring in the first generation.

By a mutation is understood a character which appeared suddenly and is inherited. Practically all mutations are inherited, according to Mendel's law. As an example of this law may be taken the inheritance of any of the two hundred or more mutations which have been found in the fruit fly. If a fly with vestigial wings is crossed with one with normal wings the offspring in the first generation will all, without exception, possess normal wings, but if these flies be crossed *inter se* a part of the offspring will be normal winged and a part will be vestigial winged in the proportion three to one, and there will be no intermediates. Normal wing is said to be dominant to vestigial wing. This law has been tested for some characters with very large numbers so that it is known with a precision comparable to any physical or chemical law.

An explanation of this peculiar ratio may be found in a study of the process of maturation and fertilization of the germ cells. When the nucleus of any cell divides there appear certain bodies called chromosomes. The number of these chromosomes is always constant for a given species and when the nucleus divides each chromosome divides. During the maturation of the egg at one stage a reduction division occurs during which the nucleus divides without the chromosomes dividing, so that the mature egg contains only half the normal number of chromosomes. Similarly when the sperm is formed there is a reduction division so that it also contains only half the normal number of chromosomes. When fertilization occurs and the sperm and egg combine the normal number of chromosomes is restored. Further, a more careful study of chromosomes has shown that those in a single cell are not all alike, but can be arranged in pairs and from the phenomena of fertilization it is clear that one chromosome of each pair was in the sperm and came from the father and one chromosome of each pair was in the egg and came from the mother.

Let us now see if the behavior of the character vestigial wing in inheritance can be interpreted in terms of the chromosomes. Whatever it may be which determines that the resulting fly shall have normal wings let us suppose it to exist in the members of a pair of chromosomes, and let us suppose that a race of normal winged flies which breeds true this "determiner" exists in both the chromosomes of the pair. Similarly, suppose that a race of flies with vestigial wings which breed true the "determiner" for vestigial is in both the chromosomes of a pair. When two of these flies are crossed the fertilized egg will have in the case of one pair of chromosomes one chromosome from the normal winged parent and one chromosome from the vestigial winged parent. We know that the offspring are all normal winged. Let us then suppose that the normal-wing determiner overpowers the vestigial wing determiner when both are together. What will happen if these offspring are bred *inter se*? Both the sperm and the eggs will be of two kinds, one with a chromosome carrying the determiner for normal-wing, the other carrying the determiner for vestigial-wing. Either of the kinds of sperm has an equal chance of uniting with either of the kinds of eggs. For every four eggs which are fertilized we get one in which the determiner for normal-wing is in both chromosomes, one in which the determiner for vestigial-wing is in both chromosomes and two in which one of the pair of chromosomes carries the determiner for normal-wing and one the determiner for vestigial-wing. Since the presence of the determiner for normal-wing in even one of the chromosomes makes the offspring have normal wings we have for every four offspring three normal winged and one vestigial winged. But these three normal winged flies are not all alike, one of them will be expected to breed true and two of them will behave as their parent, that is, will give normal winged and vestigial winged flies in a three to one ratio. When they are bred this is found to be the case.

There is a certain class of mutations which behave rather differently in inheritance from the example I have chosen. They are called sex-linked. They are not, however, to be confused with secondary sexual characters with which they appear to have nothing in common.

If a red-eyed female is crossed with a normal white-eyed male the sons and daughters are all red-eyed. If, on the other hand, a white-eyed female be crossed with a red-eyed male the female offspring are all red-eyed and the male offspring white-eyed. How can this be explained on the basis of determiners in the chromosomes? There is one pair of chromosomes which differ from the others. Those are called the sex chromosomes. They form in the female a perfect pair, but in the male one is of the type in the female pair (X) and the other has a hook (Y). It is easy to see that the sex of the fly depends on the number of X-chromosomes in its cells, a cell with two X's being female and the one with one X a male. When the female forms eggs they are all of one kind and each has an

* –Read at the Annual Meeting of The Radiological Society of North America, Chicago, Dec. 8, 1921.

X-chromosome. When the male forms sperm they are of two kinds, one with an X and one with a Y-chromosome. When an egg is fertilized by an X bearing sperm it becomes a female and when it is fertilized by a Y bearing sperm it becomes a male.

Let us suppose that the determiner for red eye is in the X-chromosome. A red-eyed male will have this determiner in one chromosome. A white-eyed female will have the determiner for white eye in both its X-chromosomes. If they are crossed we would get the result shown in the diagram The mature eggs have one chromosome bearing the white-eye determiner and when one is fertilized by a sperm bearing an X it will receive a chromosome bearing the red-eye determiner. If red eye is dominant it will be red-eyed, and because it has two X-chromosomes it will be a female. When, on the other hand, an egg is fertilized by a sperm bearing a Y-chromosome it will be white-eyed, because of the white-eye determiner received from its mother and the absence of any red-eye determiner received from its father, and it will be a male because it has only one X-chromosome.

This, then, briefly is the mechanism of Mendelien inheritance. It is upon this mehcanism that I have tested the effect of x-rays.

Preliminary experiments showed that the sterilization dose of x-rays was small compared with the lethal dose for female flies, so that flies could be sterilized without apparently affecting them in any other way.

In all experiments an equal number of control matings were kept under the same conditions as those under which were kept the rayed pairs. In the first experiments virgin red-eyed, wild-type female flies were rayed. These females were obtained virgin by isolating pupæ in test tubes. The females were rayed soon after emerging from the pupa cases with a dose just under the sterilization dose and immediately mated in rearing bottles with white-eyed males. The pairs of flies, both the control pairs and the rayed pairs, were then transferred to new rearing bottles every six days. The offspring of the pairs in each bottle were counted every day. It will be remembered that in a regular cross the offspring of a red-eyed female by a white eyed male are all red-eyed.

A word as to the results obtained in the case of the control and rayed pairs in the first bottles of the first four experiments: In this experiment the seven control pairs produced in the first bottles 545 red-eyed males and 501 red-eyed females and no white-eyed flies. The six pairs in which the females were rayed produced 81 males and 77 females; of the 81 males 10 or 12.3% were white-eyed and five out of the six pairs produced one or more white-eyed males. Further, it was noticed that the white-eyed flies are among those emerging on either the third or the eighth day. This probably means that they came from eggs which were in one of two stages of the maturation process when their female parents were rayed.

The results of the first four experiments were then combined so as to include only the offspring obtained during the first six days, the period during which white-eyed flies were obtained.

The production of these white-eyed males by x-rays may be accounted for by assuming that the X-chromosome was destroyed or otherwise eliminated by the rays.

In one experiment a white-eyed male occurred in the control. This was probably due to non-disjunction, that is, to the failure of the two chromosomes to separate in maturation and suggests that the effect of the x-rays may be to cause non-disjunction or a sticking together of two chromosomes rather than the elimination of one. The next series of experiments were carried out to test this.

Virgin white-eyed females were rayed and mated to eosin-eyed, miniature winged (both sex-linked recessive characters, eosin-eye being, however, dominant to white-eye). It will be remembered that the regular offspring of such a cross are eosin-eyed females and white-eyed males. The seventeen control females produced 1,726 regular males (white-eyed) and 1,743 regular females (eosin-eyed) and one eosin-eyed miniature-winged male. This latter was an exception due to non-disjunction occuring naturally. The 13 rayed females produced 467 regular males (white-eyed) and 512 regular females (eosin-eyed) and in addition 12 exceptional males (eosin-eyed, miniature-winged) and 2 exceptional females (white-eyed). Further, of these 13 rayed females 4 produced less than 10 offspring, and the 9 remaining rayed females, which produced more than 10 offspring, each produced either exceptional males or females. The two females were produced by different females.

It seems clear from the second series of experiments that an effect of x-rays is to produce non-disjunction or a failure of the X-chromosomes to separate in the female during maturation.

To sum up, a specific effect of x-rays has been shown in the dividing germ cell which leads to a specific modification in the inheritance of the offspring.

EDITOR'S NOTE—*This thesis was greatly amplified by a number of stereopticon slides showing the tabulated results of the various experiments conducted by Dr. Mavor, and it is matter for regret it has not been possible to reproduce them here.*

A System of Roentgen Ray Anthropometry (The Skull)

A. J. PACINI, M. D.
Washington, D. C.

PART II SECTION A DESCRIPTIVE

General Considerations

JUST as the measuring of the skeletal parts differs in many respects from that of measuring the living, so does the measuring of the skeletal and fleshy silhouettes of the roentgenogram of the head differ from either craniometry or cephalometry. Moreover, roentgen ray anthropometry is especially attractive by reason of the cleanliness of the investigation and because, unlike any other branch of anthropologic enquiry, roentgen ray anthropometry offers a field of study heretofore impossible; that of investigating the ectocranium, the endocranium and in great measure the soft coverings of the head; and all these in the living.

In this country the study of physical anthropology may be said to have begun with the researches of the immortal Samuel G. Morton in Philadelphia, in 1830. The historical development of this incident is interesting, and according to Morton himself, the beginning of his actual work in anthropology is related to have occurred as follows:

> "Having had occasion, in the summer of 1830, to deliver an introductory lecture to a course in anatomy, I chose for my subject, 'The Different Forms of the Skull as Exhibited in the Five Races of Men.' Strange to say, I could neither buy nor borrow a cranium of each of these races; and I finished my discourse without showing either the Mongolian or the Malay. Forcibly impressed with this great deficiency in a most important branch of science, I at once resolved to make a collection for myself."

With the beginning of anthropological studies in America, as initiated by Morton, it will be observed that attention is directed first to craniology. The cranium is naturally the most interesting and the most important part of the skeleton; and it is no wonder that the preoccupation of anthropology with the skull has been such as to overshadow the study of the rest of the skeleton. Craniometrical methods and instruments have multiplied perhaps a little beyond the actual need. The first earliest summary of this mass of research was made by Broca, Vogt and Topinard, and more recently has been condensed and selected so as to conform with the admitted efforts toward standardization by the Monaco and Geneva Conventions and presented in the two most valuable current contributions to anthropology entitled, respectively, (1) "Anthropometry" and (2) "Physical Anthropology," both under the authorship of Dr. Ales Hrdlicka.

Hrdlicka's Anthropometry is the model after which roentgen ray anthropometry is patterned. It will be the aim to parallel such measures and observations enumerated in Hrdlicka's "Anthropometry" as may be obtained from the study of the roentgenogram; to supply, for the same subject, such cephalometric measures and observations as the roentgenogram may provide in accordance with Hrdlicka's standards; and in addition, as nearly as possible to approximate such other useful anthropologic characteristics as may prove of value in the immediate application of roentgen ray anthropometry to clinical studies.

Certain preliminary procedures are considerably important and must necessarily be observed before beginning either a description or measure of the skull. These are included under three general heads, namely, (1) sexing; (2) estimation of the age, and (3) determination of normality.

Sexing

Female crania differ from the male by the same characters which tend to distinguish the female skeleton from the male skeleton. Ecker early remarked on the lesser development of the processes serving for the attachment of the muscles in the skeleton of the female, a process especially perceptible in the mastoid prominence, the temporal and cervical lines, and the ridges on the lower jaw. In the male skull the protuberances of the osseous cavities are more developed, as is seen in the superciliary ridge produced by the bulging of the frontal sinuses. In regard to the size it has always been accepted that the female skull is absolutely smaller than the male skull; Welcker furnished accurate information on this topic in 1862 for the first time. Ecker in 1866 studied the proportion of the cranium to the face as a whole, and that of the separate parts, and concluded that the female cranium presented certain cranio-facial relations that distinguished it from the male cranium. This subject has more recently been revived under the topic of cranio-facial index mentioned by Bean, and will be referred to again later in this thesis.

Topinard remarks that sex can not be recognized with infallible precision from any one character, but is inferred from the study of a group of characters, among which he names the shape of the feminine head, intermediate between that of the infant and adult man; the general gracefulness and fineness; the lesser prominence of the muscular insertions and the bony processes. The following points, says Topinard, should receive preferential attention; the forehead which is, all other things equal, straighter in the female than in the male skull; the superciliary ridges and the glabella, infinitely less developed in the female; the high and horizontal vault of the feminine cranium; the relatively less capacity and weight of the skull; the mastoid and the styloid processes, both of conspicuously less development in the feminine as compared to the masculine skull; and the massiveness of the zygoma and the alveolar processes, less in the female than in the male.

As Hrdlicka remarks, there are male skulls which in some or all of their features are less masculine than the average; and similarly, there are female skulls that in some or all of their parts resemble the masculine. There is no sharp dividing line, but rather an interdigitation and continuity, as a result of which, in certain cases, the sexual identification of a specimen remains uncertain despite all the efforts of the anthropologist.

Roentgen ray anthropometry introduces the concept of the "summation of sex characters." In roentgen ray anthropometry, as conducted on the living, the sex is definitely known; and it might appear at first consideration, superfluous, to conduct any observations bearing upon sexual identification. It was observed, however, that in certain types of mental deficients showing strongly developed homosexual traits, that the summation of sexual characters as obtained from a study of the cranial roentgenogram often leads to inferences that were at variance with the true anatomical sex of the individual. It is felt that this observation is fraught with intrinsic potential value in the study of mental deficients from the viewpoint of anthropology; and also that it may lessen the percentage of inferences in the identification of the sex of crania as practiced by the anthropologist who has no way or means for checking the accuracy of his observations.

The instructions given by Hrdlicka for establishing the sexual identification of a cranium are, in summary, as follows: The observer notes first the size of the vault as well as that of the face; a large size speaks normally for a male and the small size for a female. The features observed next and in the order named, are the supraorbital ridges, the mastoids, the zygomata, the occipital crests, the lower jaw, the palate and the teeth, the facial "physiognomy" and the base of the skull.

Size

The roentgenogram lends itself to the study of many of these characters, such as the size, the smoothness, the supraorbital ridges, the mastoid process, the zygomata, the angle and the strength or massiveness of the lower jaw. As mentioned previously, Welcker established what had always been accepted, that the female skull is absolutely smaller than the male skull. It is sufficient to record the size of the cranium as revealed upon the roentgenogram according to the following nomenclature:

Size

Female	1 very small	
	2 small	
	3 intermediate	
	4 large	Male
	5 very large	

These terms are purely qualitative and would vary for studies applied to different races; but in a series limited to one race they acquire a more nearly quantitative value. Arbitrary values have been assigned according to the descriptive terminology; so that a very small head of any series could be arbitrarily valued as one, and a very large head in that same series would receive a value of five.

Smoothness

Having observed the size of the head and recorded its arbitrary value, the investigator next examines the smoothness. The smoothness is manifested by the gracefulness of the cranial curves, by the absence of step-like depressions or elevations along the median sagittal suture, but more especially at the bregma, lambda and the occipital crests. It may be recorded, pursuant to the general method of roentgen ray anthropometry, according to the following nomenclature:

Smoothness

Female	1 very smooth	
	2 smooth	
	3 intermediate	
	4 rough	Male
	5 very rough	

Supraorbital Ridges

Next in order the supraorbital ridges are studied. On the average these are decidedly more developed in the male than in the female. According to Bianchi, in human crania the spongy tissue of the frontal bone above the nasion becomes absorbed between the sixth and eighth years of age and thus initiates the formation of the frontal sinuses. This is furthered by the evagination into this spongy tissue of the mucous membrane lining the nasal cavity, and by the exertion of this membrane of its osteolytic capacity (McMurrich). According to Sappey, at puberty and after, the sinuses dilate, thus accentuating the glabella and making prominent the superciliary ridges. Mantegazza believes that the sinuses continue to increase in adults and even in the aged. Bianchi established the independent development of the superciliary ridges apart from the simultaneous development of the frontal sinuses; and it is common experience to note that the congenital absence of frontal sinuses is not necessarily accompanied by absence of the superciliary ridges. The degree of development of the superciliary ridges or supraorbital ridges may be characterized as follows:

Supraorbital Ridges

Female	1 trace	
	2 slight	
	3 moderate	
	4 medium	
	5 pronounced	Male
	6 excessive	

It is the rule that pronouncedly or excessively developed supraorbital ridges are never observed in the female; neither are ridges that might be classed as "traces" found in adult males. Schaaffhausen attributes the more marked superciliary ridges in man than in woman to the relation which exists between muscular development and the projection of the brows.

Broca traced the superciliary ridges and provided a scale from zero to four, which is here reproduced. It is not necessary that this scale should be rigorously applied. The terms above employed are adequately descriptive. A supraorbital ridge somewhere between number zero and number one of

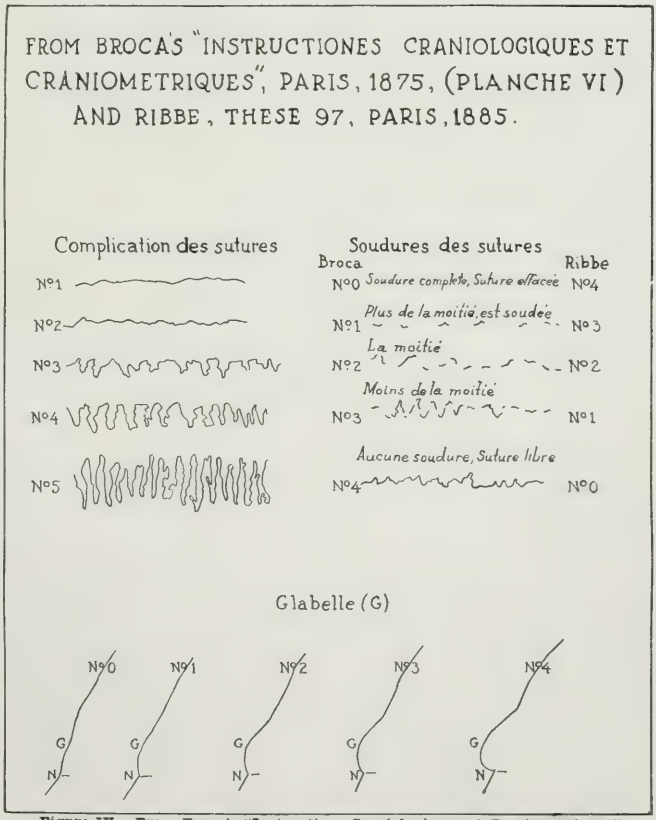


Figure IV.—From Broca's "Instructions Craniologiques et Craniometriques" Paris, 1875. (Planche VI.) and Ribbe, These 97, Paris, 1885. showing a scale for interpreting suture serration; a scale for quantitatively recording suture occlusion; and the degree of protuberance of the superciliary ridge or glabella.

Broca's four would be called excessive, and a protuberance more marked than Broca's four would be called excessive Qualitative degrees between these two would be slight, moderate, medium and pronounced (see Fig. 4).

Mastoid Process

Next in order the study of the development of the mastoid process is important. This process is formed by the posterior extremity of the petrous bone and is relatively small at birth, when it contains no air cells excepting in the antrum. It develops and becomes permeated with cells as age increases. Its development is largely determined by the sternocleidomastoid muscle which inserts into the mastoid process of the temporal bone. Male mastoids are larger than female processes; so that small mastoids do not occur in males, neither do large or excessive mastoids occur in females. In the median sagittal projection of the skull, on the roentgenogram, the mastoid process must be sought with great care, as in this exposure its silhouette is superimposed over the shadow of the bodies of the atlas and axis.

An estimate of the degree of its development is best gained by visually completing the basi-occipital rotundity and noting the size of the triangular silhouette projected by the mastoid process as it extends from this rotundity with its base attached to the occiput and its apex pointing downward and forward. From the length of the basilar attachment to the occiput, and the height of the triangular apex, the size of the mastoid process is accurately judged. The values for the mastoid process are:

Mastoid Process

Female	1 small	
	2 moderate	
	3 medium	
	4 large	Male
	5 excessive	

Zygomata

Panichi was early impressed by the protuberance of the zygoma, an anatomic entity that had previously attracted the attention of Luschka and one of his disciples, Werfer. Panichi was interested more especially in the study of the zygomatic spines which he described under eight types; and for which he developed an index based on the relation that exists between the height of the pyramidal protuberance and the height of the spine referred to the standard of 100 (height of the pyramidal protuberance : the height of the spine : : 100 : x). Hrdlicka mentions the massiveness of the entire zygoma as a criterion useful in the distinction of the sex. Zygomata are recorded as:

Zygomata

Female	1 small	
	2 moderate	
	3 medium	
	4 large	Male
	5 excessive	

Unless care is exercised in producing the cranial roentgenogram the zygoma (sinistral) is not clearly outlined. The massiveness of the zygomata may be in part inferred from the size of the antrum of Highmore as well as from the distinctness of the outline of the zygomatic arch as it courses backward to the glenoid fossa. Only the most slender zygomata escape definite visualization.

Mandible

Morselli in 1875 presented a study on the relation that existed between the weight of the skull and the mandible; and arrived at the conclusion that the inferior mandible of the male is heavier than that of the female; and that the sexual character of the weight of the mandible is an important craniometric criterion for distinguishing between sexes. Mingazzini, elaborating on the previous work of Sandifort and Meckel, communicated his study on the morphologic significance of the angle of the mandible. When the roentgen ray exposure is made according to the formula outlined in Part I, the projection of the sinistral half of the inferior mandible is moderately distorted owing to ray divergence. Any measures that are to be made may be corrected through the method before prescribed; but these corrections need not be applied if it is desired only to gather a qualitative inference of the degree of angularity or a lack of angularity observed in the mandible. The angularity of the lower jaw, as revealed by the prescribed technique on the roentgenogram, may be recorded as:

Lower Jaw

Female	1 very obtuse	between 125–130 degrees	
	2 obtuse	between 120–125 degrees	
	3 intermediate	between 110–120 degrees	
	4 acute	between 100–110 degrees	Male
	5 very acute	between 90–100 degrees	

In addition to the angularity the massiveness of the jaw is an important criterion. This may be gauged somewhat from the height of the symphysis; but in judging the height, the size and strength of the mandible should at the same time be observed and their value included in the estimate of that for the height, as follows:

Lower Jaw

Female	1 very low	
	2 low	
	3 intermediate	
	4 high	Male
	5 very high	

For convenience in recording the sex characters of the cranium a roentgen ray anthropologic chart may be prepared according to the copy presented. The chart is devised so as to record the observation on five crania. The characteristics are observed in the proper order, as indicated on the chart, and the value checked opposite the figure in the column for the skull under study. Following the last evaluation, which is that for the height and massiveness of the lower jaw there is a space for recording the total sum of character value; and underneath this the name, age, sex, height, weight, physical condition and clinical diagnosis of the patient are included. (See mimeographed form, page 326).

Sex Value

Obviously the most typically feminine skull in a series would present a summation of the lowest value for each characteristic, which is, according to the scale devised, 7; and similarly the most typical male skull in that same series would be represented by the sum of the maximum characteristics, which is 36. These extreme values are seldom observed. The average between the minimum female characteristics, 7, and the maximum male characteristics, 36, affords a mean of 21.5. The figure 21 may be used to represent the critical sex value. Figures above 21 represent dominantly male individuals, and figures below 21, dominantly female.

The application of this study to the roentgenograms of crania of homosexuals has in certain series presented the peculiar finding that the summation of sex character values in some males was found lower, and in some females higher than 21. This is not only of anthropologic interest, but is also clinically significant to the psychiatrist in pointing to the possibility of viewing the homosexual as a phylogenetic entity of ontogenetic misfitness; or to use the words of a leader in psychiatry to whom these observation were presented "roentgen ray anthropometry for the first time affords an accurate means for observing the biologic male in the anatomic dress of the female."

Skull Thickness

On the thickness of the vault much has been written; and it was thought by some, as for instance Schaaffhausen, that most of the skulls of the highest antiquity are distinguished by the thickness of the cranial bone; but this

may partly be due to great muscular action, and partly to mode of life, which furnished in some cases an excess of calcium phosphate for the nourishment of the bone. So that thickness of the vault, alone, is of no decisive value in sexual identification.

Estimation of Age

A correct estimate of the age from the skeleton is not of extreme anthropologic necessity. Generally it suffices to determine whether the skull is subadult, adult or senile. For these determinations the anthropologist studies the state of fusion of the basilar suture, that of the epiphyses of the long bone, the stage of dentition, the condition of the teeth and alveolar processes, and the state of the sutures of the vault of the skull (Hrdlicka).

In sagittal view, the basi-sphenoidal suture is not roentgenographically visible; so that its occlusion, a sign valuable to the anthropologist, can not be utilized by the roentgenologist. A study of the epiphyses of the long and other bones is possible, though it necessitates additional roentgen ray exposure. Hrdlicka offers the following table, based upon modern anatomical writings, for the ossification of the various epiphyses:

Ossification (Completed)

		Year
Basilar suture		20–25
Humerus:	upper	20–25
	lower	18–19
Femur:	upper	18–20
	lower	20–22
Tibia:	upper	20–24
	lower	18
Ulna:	upper	16
	lower	20–23
Radius:	upper	17–20
	lower	20–25
Fibula:	upper	22–25
	lower	19–20

	Year
Scapula	20–25
Clavicle, sternal end	25
Sternum	20–25
Ribs	25
Vertebrae	25
Atlas	18
Sacrum (union of uppermost segments)	25–30
Ossa innominata	20–25
Phalanges	18–20

Based on the roentgenographic study of 30,000 cases, given by Pacini, the age of fusion of various epiphyses coincides very closely with the age of those offered by Rotch and Morris. The comparative tables are appended. (Tables of Rotch and Morris modified and copied from Holmes and Ruggles, "Roentgen Interpretation.")

		Age of Fusion (Rotch & Morris)	Age of Fusion (Pacini)	No. of Cases in Average
Ribs:	Epiphyses for head and tubercle	23		
Clavicle:	Small epiphysis of the sternal end	25	25	2360
	Epiphysis of acromial end		18	2840
Humerus:	Head	20		
	Greater tuberosity	20	20	950
	Lesser tuberosity	20	20	950
	(All fuse at six years and join the shaft at twenty years).			
	Capitellum	17		
	Internal epicondyle	18	18	18210
	Trochlea	17		
	External epicondyle	17	16–17	2005
	(The capitellum, trochlea and external epicondyle join as a mass at seventeen and the internal epicondyle at eighteen years).			
Radius:	Head	17	20	22506
	Lower epiphysis	20	17–18	22118
Ulna:	Olecranon	17		
	Lower epiphysis	18	18	6030
	Upper epiphysis		18–20	7292
Carpus:	(In the order of appearance).			
	Magnum			
	Unciform			
	Cuneiform			
	Semilunar			
	Trapezium			
	Scaphoid			
	Trapezoid			
	Pisiform			
Metacarpals:	Epiphyses	20	20	11680
Phalanges:	Epiphyses	18	20	11720
Pelvis:	(Pubis and ischium unite at eight years; the acetabulum closes at sixteen years).			
	Epiphyses for—			
	Crest of ilium		25	630
	Ischial tuberosity		13	28
	Anterior inferior iliac spine	20		
	Tubercle of pubes			
Femur:	Femur	19	18	2593
	Greater trochanter	18	18	2600
	Lesser trochanter	17	18	2430
	Lower epiphysis	20		
Patella:		24		
Fibula:	Upper epiphysis	24	20	983
	Lower epiphysis	20	18	992
Tibia:	Upper epiphysis	22		
	Lower epiphysis	18		
Tarsus:	(In order of appearance).			
	Calcis			
	Epiphysis of calcis			
	Astragalus			
	Cuboid			
	External cuneiform			
	Internal cuneiform			
	Middle cuneiform			
	Scaphoid			
Metatarsals:	Epiphyses	20		
Phalanges:	Epiphyses	18	20	10065
Sesamoids:	of flexor hallucis brevis			
Vertebrae:	Ossification is from three primary centers, one for the body and one for each lateral mass. The nucleus for the body is often bilobed, with a partial plane of cleavage in the vertical or horizontal diameter. The laminae unite during the first year. Five secondary centers described in the anatomies—namely,			

thin plates on the upper and lower surfaces of the body and the tips of the mammillary tubercle, transverse and spinous processes appear at the age of fifteen to twenty years and unite at twenty-five. The fifth lumbar vertebra is an exception in that it ossifies from five centers, one for the body, one on each side from which is developed the superior articular process, pedicle and transverse process, and one on each side, which subsequently form the inferior articular process, lamina and spinous process.

If the study is directed with the immediate aim of definitely ascertaining the age of the subject, careful roentgenography of the various bones and their epiphyses should establish the age within one or two years when the individual is under thirty; but it is seldom necessary or desirable to direct an inquiry entirely for the estimation of the exact age.

Teeth

The eruption of the temporary and of the permanent teeth is a useful indication of the age of the subject. Deciduous dentition, among whites, is complete usually before the end of the third, and permanent dentition before the thirtieth year of life. A complete set of teeth in a skull is a valuable index pointing to the fact that adult life has been attained, or nearly attained. Bean gives the following order for the eruption of the permanent teeth:

1. Lower first molars,
2. Lower median incisors,
3. Upper first molars,
4. Upper median incisors,
5. Lower lateral incisors,
6. Upper lateral incisors,
7. Upper median premolars,
8. Lower canines,
9. Lower median premolars,
10. Upper lateral premolars,
11. Upper canines,
12. Lower lateral premolars,
13. Lower second molars,
14. Upper second molars,
15. Lower third molars,
16. Upper third molars.

From a composite study of Bean, Bednar, Cherot, Gray, Matiegka and others, Hrdlicka furnishes the following data relative to the eruption of temporary and permanent teeth in whites:

ERUPTION OF TEETH IN WHITES

First Dentition

	Months
Median Incisor, lower	4—8
Median Incisor, upper	8–11
Lateral Incisor, upper	8–11
Lateral Incisor, lower	12–15
First Molar, upper	9–21
First Molar, lower	12–21
Canine, upper	16–24
Canine, lower	16–25
Second Molar, upper	20–36
Second Molar, lower	20–36

Permanent Dentition

	Years
First Molar, lower	4—7
First Molar, upper	5—8
Median Incisor, lower	5—8
Median Incisor, upper	5—8
Lateral Incisor, lower	6–10
Lateral Incisor, upper	6–10
Anterior Premolar, upper	7–14
Canine, lower	8–14
Anterior Premolar, lower	8–15
Posterior Premolar, upper	9–15
Posterior Premolar, lower	9–15
Canine, upper	9–16
Second Molar, lower	10–17
Second Molar, upper	10–17
Third Molar, lower	15–30
Third Molar, upper	17–30

In a skull the wear of the teeth, as Broca taught, gives valuable information indicating advancing age. In the white race there is little wear before the thirty-fifth year of life, nor is it marked before the fiftieth year; and in many subjects the wear may remain slight up to very old age. Bean indicates that the decay of the permanent teeth occurs earlier in types which he calls hyperontomorphs (individuals with long faces, heads and noses, and large occipital circumferences), than in those types called by the same author

ROENTGEN RAY ANTHROPOLOGY
(Sex Character of the Cranium)

No. 1

CHARACTERISTIC	Value						
SIZE:							
very small	1						
small	2						
intermediate	3						
large	4						
very large	5						
SMOOTHNESS:							
very smooth	1						
smooth	2						
intermediate	3						
rough	4						
very rough	5						
SUPRA-ORBITAL RIDGES:							
trace	1						
slight	2						
moderate	3						
medium	4						
pronounced	5						
excessive	6						
MASTOID PROCESS:							
small	1						
moderate	2						
medium	3						
large	4						
excessive	5						
ZYGOMATA:							
slender	1						
moderate	2						
medium	3						
strong	4						
massive	5						
LOWER JAW:							
very obtuse	1						
obtuse	2						
intermediate	3						
acute	4						
very acute	5						
LOWER JAW:							
very low	1						
low	2						
intermediate	3						
high	4						
very high	5						
Total sum of character values							
Name							
Age							
Sex							
Weight							
Height							
Physical condition							
Clinical Diagnosis							

hypo-ontomorphs (individuals with broad heads, faces and noses, and large parietal circumferences of the head).

In addition to serving as a means for estimating the age, the form and state of soundness or decay of the teeth may point to the state of integrity of the endocrine secretory balance. Thus, Barker states that in status lyphaticus the two central incisors are abnormally large and the two lateral incisors very small. Delayed dentition may be a sign of pathology, such as rickets, or abnormality of cryptorhetic function (goiter, myxedema). If the first dentition is delayed, the sequence of appearance of the permanent teeth may be disturbed, and they may then be badly developed, misshapen, or eroded. Caries may be accompanied by conditions of myxedema and also dysfunction of the parathyroid glands. The position of the teeth is important, as in acromegalic changes wherein the individual teeth do not appear to change much in size, but the spaces between them become greatly widened ("hag teeth"), owing to the enlargement of the jaw, a valuable and often early sign in this pituitary disorder.

With advancing senility the bones of the skull, as well as those of the rest of the skeleton evidence rarefaction. In the jaw this is accompanied by an extensive loss of teeth and marked absorption of alveolar processes. Edentulous jaws that are greatly thinned and have assumed a pronounced and increasing obliquity are evidences of advanced senility.

Cranial Sutures

The obliteration of the cranial sutures has been used to assist in estimating the age. It is valuable when studied in conjunction with other indications. The study of cranial sutures is interesting and important, not alone from the viewpoint of age estimation, but also from that of pathology, more especially rickets.

On the roentgenogram of the sagittal view of the head, excepting in old age, the lambdoid suture is normally visible, and less frequently the coronal suture. The sagittal suture, because of its lateral projection, can be studied indirectly by noting the contact at important junctions, such as at the bregma and lambda.

As Ribbe pointed out, the sagittal suture consists of four divisions which from front to back are: (1) the bregmatic portion; (2) the vertical portion; (3) the obelion portion; and (4) the paralambdoidal portion. At the bregma there may be an elevation or depression where the sagittal meets the coronal suture; and similarly at the lambda there may be most usually a depression as the occipital bone bulges outward where the sagittal meets the lambdoidal suture. Beyond these remarks the study of the state of fusion of the sagittal suture can be inferred only from the general configuration of the head. In scaphocephaly, in which the sagittal suture is fused, lateral expansion of the vault is interfered with so that the head grows lengthwise in the plane of least resistance; and it assumes the "boat-keel" form characteristically observed in the negro, and in white skulls, and others, where the sagittal suture has early fused as the result of pathology.

Each half of the coronal suture presents three distinguishable portions. These are: (1) the bregmatic, (2) the complex, and (3) the occipital. The bregmatic portion is relatively short (Ribbe gives three centimeters as the average length). A great part of the bregmatic portion of the coronal suture is in a more or less horizontal plane and is, therefore, not projected on the roentgenogram of the sagittal view of the head. The complex portion is so named because of the intricacy and length of the tortuous dendrites that compose it. This portion of the coronal suture is more nearly vertical in its position on the cranium and when patulous it is projected onto the roentgenogram. It is practically the only portion of the coronal suture that is all clearly visualized on the roentgenographic plate. The third or temporal portion of the coronal suture is free from serrations and is very compact and linear. It ends at the pterion where it meets the equally compact sphenoidal suture. This portion is rarely observed in a roentgenogram of adolescent or adult crania.

Ribbe similarly divides the lambdoidal suture into three portions. The first he describes as descending four centimeters from the point of its departure from the sagittal suture and as presenting many varieties and modifications. The second portion, like the second portion of the coronal suture, is complicated and intricately serrated. The third portion begins where the second ends and runs, practically rectilinearly and compact to the asterion. When the skull structures are sagitally projected the first portion of the lambdoidal suture is virtually superimposed upon the shadow of the cross section of the occipital bone, and is, therefore, roentgenographically invisible. The second portion of the lambdoidal suture, like the second portion of the coronal suture, is visible in the vast majority of skull roentgenograms; whereas the third portion, quite similar to the third portion of the coronal suture and for similar reasons, can not be at all defined.

It seems to be generally agreed that in very early life the endocranial structure of the sutures corresponds morphologically to the ectocranial structure; but as age advances the endocranial aspect loses its serrations, straightens and begins to fuse, whereas the ectocranial aspect straightens to a small extent, more generally fusing without much loss in serrated structure. In reporting suture serration as observed on the roentgenogram, the notation introduced by Broca and modified by Ribbe and Zanolli may be employed. Broca, in his principles of craniologic instructions, produced a table of serrations. (See Figure 4). Ribbe says, of Broca's table: "Evidently every degree of possible serration is not represented by one of these five types; one may observe many intermediate types; but these may be easily expressed in terms of the figure immediately lower than the type to be classified, augmented by a fraction representing the degree between the immediate lower figure and the next higher." Broca also introduced a table for recording the fusion of the sutures. Ribbe uses this table, changing only the number value for the order of the fusion (See Fig. 4). In concluding his study Ribbe offers the following information relative to the order of sutural obliterations:

> "In the internal table of the skull, synostosis begins at the level of the obelion and from there propagates by continuity either forwards or backwards to the asterion or to the sphenoid. The temporal sutures are the first to seal.
>
> "The order of sutural obliteration is as follows: (1) sagittal, (2) coronal, (3) lambdoidal. Occasionally, in the proportion of one time in three, the lambdoid fuses before the coronal. In the external table, synostosis appears generally in the region of the obelion among colored and in a great majority of superior races. The sagittal divisions fuse in the following order: (1) obelion, (2) vertex, (3) posterior region, (4) anterior region. The order of fusion of the coronal suture is as follows: (1) temporal, (2) bregmatic, (3) complicated division. This order is somewhat confused among Chinamen, Malays and Peruvians. The order of fusion for the lambdoid suture is as follows: (1) lambdoic portion, (2) median portion, (3) inferior portion. Near the pterion, the spheno-frontal suture closes before the spheno-parietal suture. The mastoido-parietal suture in

nearly all races is one of the last to fuse. Ossification normally appears in the external tables of superior races at about twenty years of age in the youngest and fifty-five at the very latest, averaging between forty and forty-five years of age. In inferior races these fuse between twenty-five and twenty-eight years of age. The progression of fusion of sutures is the same internally and externally, although frequently it is asymmetrical at the levels of the transversal and lateral sutures. It is in general more advanced on the right for the lambdoid, on the left for the coronal and peripterion sutures. The majority of human crania are asymmetrical.

"In young individuals the internal table of the skull shows dentations that disappear with age and fuse into the diploe."

Zanolli, in a study of the obliteration of the cranial sutures, quotes Ribbe, Testut, Tidy and Topinard, but concludes that the ectocranial construction is an insufficient criterion from which to judge the probable age of the individual, stating that the endocranial construction is more important. Zanolli further infers that the order of sutural occlusion is neither regular nor constant; that it is apparently more precocious in the male, where it becomes manifest mostly at about twenty-five years, than in the female, where it is delayed to about thirty years; and that sutural obliteration appears to be more regular and orderly in the female than in the male.

Dwight, in the study of one hundred observations, which study is, however, culled from an assortment of skulls so mixed with regard to sex and race as partly to vitiate any absolute inferences, arrived at the conclusion that the sutures begin to close at a much earlier age than had ever before been stated; that the closing almost invariably begins endocranially, although the process does not at all necessarily appear first on the outside opposite the points previously fusing on the inside; and that the time of closure of any particular part of a suture, and the order in which the process advances, are very uncertain. Dwight then offers his opinion as to the usual order for the closure of sutures, as follows:

"I think that closure generally begins in the back part of the sagittal and often as soon or nearly as soon in the lower ends of the coronals. I think that when the sutures close early the coronal usually closes before the lambdoidal, but that in old skulls, on the outside, at least, the lambdoidal is more frequently obliterated than the coronal. On the inside of old skulls there is very often a minute line showing the position of the apex of the lambdoidal suture when all the others are quite gone. A persistent frontal suture is one of the last to disappear, as has been previously taught.

"As to the rules for determining the age of the skull from the condition of the sutures, it is necessary only to compare them with the observations recorded in this table to see what they are worth. It must not be forgotten that there are other guides to the age of the skull; and I am not prepared to assert that, taken together with them, the sutures are absolutely worthless in the hands of an experienced anatomist. I am sure that to anyone else the rules in question are misleading and dangerous."

Parsons and Box, in a detailed study completed in 1905, corroborate the conclusions arrived at fifteen years before by Dwight, that the closure of sutures may occur in a healthy skull before thirty, though it is rare, and, for practical purposes, the absence of any internal obliteration should fix the probable age at less than thirty. Parsons and Box further add that:

"Over thirty there is always a fair amount of obliteration of the coronal and sagittal sutures internally, while over fifty usually, and over sixty always, all the entocranial sutures are obliterated.

"The ectocranial sutures are so variable that no estimate of age should be made from them when the inside of the skull can be looked at, and the fact that so few museum skulls are opened detracts very much from the practical value of many of our great collections.

"With regard to the place at which ossification usually begins, Dwight is doubtful whether it is below the stephanion or at the obelion, though he rather favors the latter place, and other authors seem divided in their opinions. Our own evidence makes us think that somewhere in the lower half of the entocranial aspect of the coronal suture obliteration usually commences, and that this is followed very rapidly by external obliteration of the same suture below the stephanion where the temporal ridge crosses it.

"The sagittal suture seems to close internally about the region of the obelion, and soon afterwards at its anterior part, the posterior inch sometimes remaining patent after all the rest is obliterated. There can be no doubt that the accepted statement that the suture first closes externally at its simplest part, that is, at the obelion, is correct, though this is subsequent to the internal appearance of obliteration, and is often delayed till old age is reached. Picozzo says that in the male the obelion first closes, and in the female the middle of the sagittal suture, but if he is referring to the outside of the skull all our evidence goes against this statement as far as females are concerned.

"The lambdoid suture closes later than the coronal and sagittal as a rule; this we are not surprised to find, when we remember its markedly serrated appearance. As far as the three sutures with which we have alrady dealt are concerned, the rule seems to be that the simpler the suture the earlier its closure, and this holds good with the spheno-parietal and spheno-frontal sutures, which are always closed when closure has occurred beneath the stephanion, though it does not apply to the squamous suture, which closes very late, if at all. Taking the ento-cranial closure of the lambdoid, we find that, out of twenty-six skulls below forty, it is only closed in five. After forty closure is more usual, and a careful review of our records makes us believe that obliteration generally begins midway between the lambda and the occipito-mastoid articulation, and that the upper part near the lambda closes last. On the outside of the skull the closure of the suture is later, and the upper part is often the earliest to close, thus bearing out Dwight's contention that the ecto and entocranial points of obliteration do not necessarily correspond. We have no evidence, on the other hand, that Dwight's statement, that, when the sutures close late, the lambdoid is usually in advance of the coronal ectocranially, is correct.

"In our eighty-two skulls six showed signs of a metopic suture, and the evidence of this small number shows that, as in other sutures, entocranial precedes ectocranial closure. Apparently internal obliteration begins at the lower part. It is sometimes taught, though we are unable to trace the statement to its source, that when the metopic suture fails to close

at its usual time it is the last of all to be obliterated. Our records, as far as they go, do not induce us to place much reliance on this.

"With regard to the side on which closure first begins, Sauvage ("*Sur l'etat senile du Crane*," *Bulletin de la Soc. d' Anthropologie*, Paris, 1870) says that both in the coronal and lambdoid sutures the right closes before the left. In our records there are only two in which the obliteration has been caught in a unilateral condition, and in both these it is the left side on which it is commencing. We are in agreement with Picozzo that male skulls are obliterated somewhat earlier than female."

For purposes of roentgen ray anthropology the serration as it manifests on the roentgenogram may be reported as:

None—Slight—Medium—Complex

If it is thought desirable, the standards proposed by Broca or advocated by Ribbe and others, may be used; and the qualitative descriptions above enumerated are quite sufficient if they are applied with diligent care. Only the middle portion of the coronal suture and the middle portion of the lambdoidal suture are of significant interest to the roentgenologist. In normal skulls when the middle portion of the coronal suture is at all visualized with any of its serrations in the male skull the age of the subject is less than thirty; in the female less than thirty-five; and for the middle portion of the lambdoidal suture, its visibility indicates in the male fifty or less years, and in the female fifty-five to sixty years. These values are based on relatively few observations and can not be considered entirely accurate; nor is it advisable that unusual care be exercised in inferring the age from the state of fusion of the various sutures by reason of the great difficulty confidently to exclude the effect of pathology on these structures.

Suture Synostosis

Premature synostosis of the sutures is meant to convey that the fissures of the skull ossify before their usual or normal time. The synostosis of certain sutures may be present at the time of birth, or may set in during the first months after birth; but usually it makes its appearance at a much later period. The cause of premature synostosis is not definitely known. It is assumed that the most usual cause is a constitutional skeletal disease, particularly rachitis. Premature synostosis has been referred to as a racial peculiarity; and the conjecture has been advanced that synostosis may result from the pressure of bones that bear against each other in the fetus during uterine confinement or at the time of labor. That uterine confinement and labor may have some influence on the subsequent shape of the skull is in part subscribed to by the findings of Mueller, who teaches that the obstetrical presentation of the child at birth casts its influence on the newborn head so that the shape remains thereafter permanently moulded according to the type of presentation. Gross irregularities produced by premature synostosis appear as a result of the fact that the skull is unable to increase in size in the direction perpendicular to the plane of the obliterated suture. Cranial deformations that arise as the result of premature synostosis have been classed by Virchow, quoted by Topinard, as follows:

1. Dolichocephaly.

(a) Median-superior synostosis; simple dolichocephaly through synostosis of the sagittal; varied or sphenocephaly, in which there is a compensatory development in the bregmatic region.

(b) Synostosis of the lateral-inferior including leptocephaly by fusion of the frontal and sphenoidal, and klinocephaly by fusion of the parietal and sphenoidal or temporal.

2. Brachycephaly.

(a) Posterior synostosis, comprising pachycephaly by fusion of the parietal and occipital, and oxycephaly by fusion of the parietal and occipital or temporal and compensatory development in the region of the bregma.

(b) Antero-posterior and lateral synostosis, comprising platycephaly by fusion of the lateral, frontal and parietal; trochocephaly, by fusion of the parietal and a part of the frontal; plagocephaly, by fusion unilaterally of the parietal and frontal.

(c) Median-inferior synostosis: Simple brachycephaly by precocious fusion of the sphenoidal basilary suture.

Lucae has also proposed a classification introducing new terms for every eccentric shape according to the following self-explanatory denominations:

Acro-cephaly	Lepto-cephaly
Hypsi-cephaly	Trocho-cephaly
Oxy-cephaly	Megalo-cephaly
Platy-cephaly	Macro-cephaly
Tapino-cephaly	Micro-cephaly
Chamoe-cephaly	Plagio-cephaly
Dolicho-cephaly	Klino-cephaly
Brachy-cephaly	Cymbo-cephaly
Megisto-cephaly	Scapho-cephaly
Brachisto-cephaly	Spheno-cephaly
Steno-cephaly	Trigono-cephaly
Eury-cephaly	Pachy-cephaly

As Stocking so well says:

"There seems to be some confusion in the terminology used for the various shapes of heads. This is perhaps due chiefly to two causes, the first one of which is undoubtedly the fact that anthropologic interest seems to have been the most common reason for research and classification up to the present. Whereas it appears to us as being more important to physicians that what there is of clinical significance attached to the different shapes of skulls, both as to etiology and symptoms, should be the feature kept uppermost in mind.

"The second cause for confusion seems to be that too many minor details have crept into the differentiation, and the gross general distinctions have been more or less lost sight of amid the plethora of technical terms.

"It is not difficult to illustrate the confusion of terms in the various classifications by referring to the literature. In German works on the subject 'Turmschaedel' has been generally used to describe a particular kind of head, for which authors in other languages have used terms less descriptive. 'Oxycephalus' is one of them. This word means a pointed head, which is by no means the commonest type of Turmschaedel. Others have used the word 'acrocephalus,' the first portion of which is derived from the Greek word 'akron,' meaning top or extremity, and which we make use of in the word 'acromegaly' in reference to enlargement of the distal portion of the body. Still others have used the term 'hyperbrachycephalus,' which yet does not describe the condition as acceptably as the word 'turmschaedel'."

From these considerations it appears that pathological deformations of the vault may be classed into three general groups, as suggested by Hrdlicka: (1) Scaphocephaly, where the vault is abnormally prolonged and the sagittal suture more or less resembles the keel of a boat. This deformity, which may be accompanied by an annular retrocranial depression, is due to the premature occlusion of the sagittal suture, and is particularly common among American negroes; (2) acrocephaly, or abnormal increase in the height of the fore part of the vault, due in the main to premature occlusion of parts of the coronal suture; (3) plagio-cephaly, or asymmetry of the vault produced mostly by

premature occlusion of the coronal or lambdoidal suture on one side.

Scaphocephaly, said Minchin and Baer, results by reason of the existence of a single center of ossification for the two parietals; and, said Morselli, because of two points of parietal ossification. But Welcker completely overthrew these erroneous theories. Two types of scaphocephaly may usually be distinguished and are called by Topinard ordinary and annular. In ordinary scaphocephaly the median sagittal suture is lengthened and there is usually a ridge-like bulging of its entire course. Ordinary scaphocephaly may be dominantly frontal, occipital or parietal. Annular scapheocephaly is distinguished by a circular depression found immediately posterior to the coronal suture and giving the skull the appearance, when sagitally viewed, of being composed of two lobes, one anterior and the other posterior.

Acrocephaly may also occur in two distinguishable types. In the first type the skull is raised and resembles a round crown or turret (the turricephaly or turret head of Stocking). In the second type the vault presents the appearance of a rounded bowl.

Acrocephaly is a characteristic of such peculiarity as to attract immediate attention, and may be noted in the living in those individuals of exceptionally high forehead.

Plagiocephaly may result from various causes: (1) A congenital inequality in the two halves of the cranium incident to an inequality in the cerebral hemispheres; (2) the arrested development of a particular cranial segment, as one of the cranial bones; (3) induced flattening, either intentional or as the result of infantile posture in children, as studied especially by Walcher; (4) chronic torticollis; (5) hereditary ethnical deformation derived from exaggerated plagiocephalic parent (Topinard); (6) synostosis of the coronal or lamboidal sutures. The most common cause of plagiocephaly following premature synostosis is that due to the fusion of the coronal suture either of one of its halves or in its entirety. Fusion of the lambdoidal suture is a less common cause of plagiocephaly.

Besides scaphocephaly, acrocephaly and plagiocephaly, Topinard would include trigonocephaly, described by Welcker and Virchow as due to the congenital synostosis of the mediofrontal suture. Viewed from above, the head presents a generally triangular shape, with the apex at the forehead. In addition to these pathological deformations the non-intentional and intentional artificial deformation may be met in dealing with primitive peoples. Hrdlicka summarizes a description of these variations as follows:

"Intentional artificial deformations, which are particularly common in certain parts of this continent and among certain Pacific Islanders, are designed shapings of the head of the new-born infant, as a result of an habitual or religious observance. They are produced by the continued application of direct pressure, by board and pad, bandage and pads, or by a bandage alone, to the head of the new-born. They are of three main classes, namely, frontooccipital (flat-head), circumferential ('macrocephalous' or 'Aymara'), and occipital.

"The 'flat-heads' are characterized by a greater or lesser flattening of the front, a corresponding flattening of the occiput, a compensatory bulging of the parietal regions, a more or less marked depression along and just posterior to the coronal suture, and occasionally a more or less marked depression along the posterior portions of the sagittal suture. When pronounced, the last named condition gives rise to the so-called bilobed crania.

"The 'Aymara' deformations are characterized by a more or less marked, broad, circular flattening or depression passing over the frontal bone, the temporal squammae and the lower parts of the parietals, and over the lower portion of the occipital, while the posterior and superior portion of the parietals and the upper part of the occipital protrude in a compensatory way upward and backward. Anterior to the coronal suture in these cases there is generally an elevation, while posterior to the suture we find a more or less pronounced annular depression.

"The occipital deformations resemble those produced accidentally, but in general are more marked. They may represent merely a favored and perhaps assisted incidental flattening due to the resistant head cushion, as among the Navahos and Pueblos; or they may occur, due to less effective methods, as by-products of the flat-head deformation with help of bandages, as among the old Peruvians. These deformations generally involve parts of the parietals, and may be median or lateral. They result in shortening, elevation and broadening of the vault, and in making the forehead both higher and more vertical."

The pathologic deformations described have as a basis anomalies in the bony metabolism of the cranial skeleton. In addition, certain deformations may arise as the result of encephalic changes, more particularly hydrocephaly and the changes incident to microcephaly.

Size of Skull

To begin with, the size of the skull is greatly dependent upon the size of the brain; although the cranial skeleton and its contents may be developed, to a certain extent at least, independently (Gratiolet reported the case of an infant in whom the cranium presented a normal conformation; but the brain was, nevertheless, almost entirely undeveloped and wanting). When, in the skull, there accumulates an undue amount of fluid, as in hydrocephaly, increase in the pressure bulges the cranium so as to augment its size; and the distribution in the lines of force of the pressure is such as to be exerted from the resistant bony base against the resillient membranous vault. If the fluid accumulates during intrauterine existence, or shortly after birth, the relatively great plasticity of the membranous vault bulges equally and radially from the bony base. It is in these cases that the median sagittal curve of the vault traced from the nasion to the inion presents a nearly perfect hemispherical projection. If the fluid accumulation begins after the membranous vault has begun to ossify, and has lost much of its initial plasticity, the pressure exerted by the increasing fluid will be spent against the parts that offer relatively minimum resistance; and since, in the infant, the anterior fontanelles and frontal region in general remain more plastic for a longer period than the posterior cranial sector, acquired hydrocephalus manifests as a bulging more prominent in the frontal than in any other region.

It will be found that in general the majority of abnormally large skulls are hydrocephalic. Virchow suggested a two-fold nomenclature for enlarged skulls, calling increases in size due to enlarged brain cephalonic, and increases due to the accumulation of abnormal quantities of cerebrospinal fluid, hydrocephalic. He further subdivided cephalonic skulls into normal and pathologic, in which the normal show a cranial base that is proportionate to the cranial vault, and the pathologic show a vault that has increased proportionately more than the base. From the roentgenogram it is sometimes possible to differentiate between hydrocephalus and cephalonia; and this differentiation accomplished, the distinction between normal and pathological cepha-

lonia can be made by the roentgen ray anthropometric study of the proportion that exists between the base and the vault (Anton and Ehrich have discussed the occurrence of cerebral hypertrophy leading to cephalonia as being in some cases a congenital affection frequently associated with aplasia of the suprarenals and with persistence of the thymus).

Hydrocephalus may be congenital or acquired. In addition to the strikingly characteristic enlargement and deformation of the skull that accompanies both congenital and acquired hydrocephalus, there are changes in the orbital roofs and also in the sella turcica, in which the latter, by pressure of the accumulating fluid, is in some instances flattened and widened. It seems that the facial cranium suffers little or no affection in hydrocephalic changes; so that the cranio-facial index, subsequently to be described, affords a means of inferring, from the roentgenogram, the probability of cranial deformation incident to hydrocephaly.

In contradistinction to hydrocephaly the abnormally small head may be soon recognized as microcephaly.

Microcephaly

Microcephaly is found in two types of subjects. In the first, the intelligence of the individual is conserved, but in the second, it is associated with idiocy or imbecility. It consists of a reduction in the volume of the cerebral mass, or of portions of the encephalon, more especially the posterior or anterior parts. In hydrocephaly the skull is characterized by relative preponderance of the vault as compared to the lack of prominence of the face; but microcephaly manifests in the reverse order, by a full and markedly conspicuous face and a diminutive vault. According to the cranial capacity Broca distinguished two grades of microcephaly which he called, respectively, true microcephaly and demi-microcephaly. True microcephaly of Broca was associated with the smallest heads, holding a capacity of about five hundred cubic centimeters, and demi-microcephaly was intermediate between true microcephaly and normal capacity, or about one thousand cubic centimeters. True microcephaly is instantly recognized, though it is relatively uncommon. Demi-microcephaly may be so slight as to require the measure of the diameters of the skull for its appreciation; and on this point roentgen ray anthropometry affords in the living what could never before be obtained, a measure of the internal diameters of the skull. All methods for the calculation of cranial cubic contents in the living have been based on the use of the various diameters or of the cranial module without other than an estimate of the thickness of the component bones. A roentgenographic means for estimating cranial capacity will shortly be discussed in the section on measurements.

EDITORIAL

The JOURNAL OF RADIOLOGY

A Journal of Ideas and Ideals

Published monthly at Omaha, Nebraska, by the Radiological Publishing Company for The Radiological Society of North America.

Subscriptions—In the United States, its possessions and Mexico, $5.00 yearly; Canada, $5.50; elsewhere, $6.50 the year.

Advertising rates on application. All advertising must conform to American Medical Association Rules.

Payments for subscriptions and advertising must be made to Radiological Publishing Co., in New York or Chicago Exchange.

Address all communications to Business Office, 305 Arthur Building, Omaha, Nebraska.

ANNUAL MEETING
Hotel Statler, Detroit, Michigan
December 4, 5, 6, 7, 8, 1922

Introducing Mr. Public Interest

STATISTICIANS have stated so often that twenty cents of every dollar earned by the average person in the United States is paid out for medical attention, that for the purpose of considering the public interest in the profession of medicine it may be accepted as an established fact. And conceding that in the term "medical attention" are included such items as drugs, nurse hire, and other incidentals which always accrue during periods of mere indisposition as well as protracted and serious cases of illness, it still would be worse than silly to say that the public is not justified in exhibiting a very substantial interest in things medical.

Such a conclusion is warranted even if the matter be viewed in its most inconsequential aspect, or what may, for the sake of brevity, be dubbed reverse economics. That is to say, even if one confines his mental processes to the barter and trade viewpoint, or the common occurrence in things commercial of buying at bargain prices, it is impossible to reach any other conclusion than that the public has an increasing interest in the fundamental problem of the public health in its relation to the social welfare.

But even in this sort of a frothy mental delirium,—which does not in any sense comport with the importance of the question,—it must not be forgotten that the public realizes its power to punish that man who demands compensation out of all proportion to the value of the service rendered. No less in the medical profession than in commercial pursuits, the mode of punishment is registered with extreme regularity, in the one case by the withdrawal of patronage, and in the other in the bankruptcy courts. Those permanent records of good citizenship recognized in every community show that pretty generally the public is able to correctly evaluate the service of every man engaged in the practice of medicine. Evidence of that fact is to be found in the social ostracism inflicted on the professional humbug who must constantly be on the lookout for fresh pastures.

The loose thinker is pretty apt to retort that all this is too complaisant a view of the matter and that its soundness is disproven by the professional mountebank and conscienceless quack who make a mighty splurge and of whom it is admitted there are more than is good for the public weal.

But the record of man's doings, taken for a period of years, shows that while the public as such may be slow to wrath it is exceedingly vengeful when seduced with unfulfilled promises and its good faith violated by men without regard for common decency.

This is the place where the responsibility of the press begins as a preventive problem. For the moment, nothing will be said about the larger measure of duty which the press owes along the lines of educational activity in the fundamentals of correct living and health matters.

Recognizing all this, generally speaking, the press, lay and scientific, proceeds with a degree of conservatism that to the extremely nervous mentality, appears almost dead from the neck both ways. There is, however, good reason behind this plan of making haste slowly. The press is a quasi-public institution. No other man-made institution is quite so amenable to the capricious tendencies of public opinion. The public exerts peculiarly drastic measures when it feels it is being hoodwinked or deliberately sold out.

It is matter for congratulation that the majority of those publications taking up the health problem do so with marked intelligence and an appreciation for the manifold intricate involvements entailed.

In the main, it is probable that the lay press strives as earnestly as does the more strictly scientific press, to discharge its obligations in the utmost good faith and intelligence, and with due respect for the social consequences of public opinion led awry by vicious publicity.

Occasionally, however, it happens that a thoroughly reputable member of the journalistic family runs amuck, and in the process, stubs an exposed toe against a familiar though temporarily forgotten fixture that has been found essential to the conduct of a decent household.

Reference is made to the well established principle that the privileges of editorial supervision and expression carry a concomitant responsibility. That is to say, the mere publication of an article anonymously involves a greater degree of accountability than is otherwise true, on the theory that thereby the publisher adopts as his own whatever statements emerge from the shroud of the hidden author.

These things are so elementary in the life of the initiate publisher and editorial staff that their restatement here may seem unnecessary.

But justification,—if indeed justification for exposition of a sound principle is ever necessary,—for such a gross malfeasance against the accepted social decorum may be found in a comparison of a discussion appearing in Atlantic Monthly, July issue, entitled "Osteopathy, Chiropractic, and the Profession of Medicine," written by Dr. Channing Frothingham, of Boston, with one appearing in the same issue of Century Magazine under the caption "Our Medicine-Men," anonymously, "By One of Them."

In passing it is no more than fair to say that Dr. Frothingham's article is a sound exposition of both the rule stated and the subject discussed, while Dr. Anonymous' disquisition proves the wisdom of the rule by violating it, and carries a marked discredit to the publication in which it appears because of the sheer disregard for logic, common sense, and proven facts.

Whether or not one agrees with the conclusions reached by Dr. Frothingham he can have no honest quarrel with so frank and impartial a treatment of the facts, and an obvious

regard for the social welfare. It is unfortunate, to say the least, as much cannot be said of Dr. Anonymous' treatment of his subject.

Before passing to more detailed discussion of the principles involved, prudence suggests two major propositions be set up in order that they may be kept constantly and definitely in view:

1. Whether the public, speaking inclusively, is actually paying too much or too little for the medical attention it demands is a relative matter, depending, first, on what the public is able to pay, and, second, on what the public actually gets for its money.
2. By and large, health is always cheap at any price, as will testify any number of persons who have lost it and are seeking to regain it; and as is further amply proven by the total dollar value of the time men and women in the United States are absent from work every year the result of sickness and disability.

Exact figures to substantiate these two propositions are available in the public records if any one desires to go into that much detail.

Prudence also dictates the statement of two minor propositions which play an important part in a sincere and intelligent pursuit of this problem. They may be succinctly stated:

1. On the whole the medical profession has never been, and is not now, a money-making profession viewed in the commercial sense. This again is proven beyond serious dispute by available statistics giving the average annual gross and net income of medical men in the United States.
2. Fundamentally, the relation of the medical profession to the general public is an economic problem, because, first, it involves the ability of men and women everywhere to do a day's work, and second, because the medical profession is controlled absolutely and mercilessly by the necessity of earning sufficient money to maintain itself and its dependents on a respectable and efficient plane, contemporary social, and economic customs considered.

Introducing Dr. Frothingham

DR. Channing Frothingham, to quote from the biographical notes found in "The Contributors' Column" of July Atlantic, is "a well-known Boston physician, is on the faculty of Harvard Medical School and the staff of Peter Bent Brigham Hospital. At one time Commanding Officer, Base Hospital, Camp Devens; at another, Chief of Medical Service, Walter Reed Hospital, Washington, D. C."

From which Dr. Frothingham's professional reputation and individual citizenship is assured. He speaks both with the authority of position and the wisdom of experience. Whatever he has to say on the subject of the relation of the medical profession to the public is worthy careful consideration. Particularly sound are his suggestions that in the intelligent exercise of the powers and privileges of licensure will be found the method by which the public can be assured proper protection against much of the fraud now perpetrated under the guise of the art of healing and science of health. And because of the importance of this phase of medical practice it seems sensible to quote excerpts from Dr. Frothingham's article and offer a few comments thereon as a part of this resume.

After traversing his subject, Dr. Frothingham concludes:

> "The public should demand that all those who are to practice the healing art, in any manner, as a profession, should have a general knowledge of the established facts in medicine, and the relation of special diseases to the public health. In other words, in all the states there should be one general board of registration in medicine, and the standards established by that board shoud be high. With the education necessary to pass such a board, the sincere therapeutic enthusiast, be he osteopath, chiropractor, electrotherapeutist, faith-healer, or herb-doctor, will probably not do much harm to the individual, or be a source of danger to the public health."

Dr. Frothingham justifies this conclusion by calling attention to a fact which is obviously inimical to the public health:

> "In the states in which all those practicing the healing art are compelled to demonstrate a general knowledge of disease, by passing an examination before the state board of registration in medicine, attempts are being made to have special boards of registration created for osteopathy and chiropractic, in order that those who profess them may practice their special therapeutic procedures without a thorough knowledge of disease and its diagnosis."

Proof of this attempt on the part of non-medical men to secure public recognition just comes to us from Dr. Leon J. Menville, President of the Board of Medical Examiners for the State of Louisiana. A part of Section 13 of the Medical Practice Act of that state reads:

> "Section 13. Be it further enacted, etc., That the term practice of medicine, surgery, midwifery, as used in this Act, is hereby defined to mean holding one's self to the public as being engaged within this State in the business of diagnosing, treating, curing or relieving any bodily or mental disease, condition, infirmity, deformity, defect, ailment, or injury in any human being other than himself; whether by the use of any drug, instrument or force, whether physical or psychic, or of what other nature, or any other agency or means; or who shall examine any such person or material from such person for such purpose; whether such drug, instrument, force, or other agency or means is to be applied or used by the patient or by another person, or be for compensation of any kind or to be gratuitous."

Though the wording of this section is not as clearly stated as would seem desirable for the avoidance of misinterpretation and controversy, still it appears to be the intent of that law to define the practice of medicine as the employment of any method of diagnosing or treating disease. This is comprehensive and rational. But its force is nullified by another provision dividing the licensing powers of the Medical Examining Board, one section of it being the so-called regular board and the other representing the followers of Hahnemann.

Apparently for the purpose of guarding the medical profession against the assumption of a "holier than thou" attitude, Dr. Frothingham argues:

> "The medical profession, on its part, should not be intolerant of the study and application of any new therapeutic agent, simply because those who advocate it present their claim with more enthusiasm than is justified by the facts, or because the advocates are not trained in general medical knowledge. It is only too well established that methods for the treatment of disease have been

taken up with enthusiasm by the medical profession, only to be eventually discarded as either useless or even harmful to the patient. Also, valuable additions to the cure and prevention of disease have been made by individuals who have not been trained in medical science. The medical profession should, therefore, take up with tolerance, study carefully, and endeavor to fit into its proper place, any new therapeutic agent that is brought forward in a serious manner."

This leads to the crux of the whole situation which ought to be perfectly obvious to the well informed layman as well as physician. That is to say, it must be recognized that the question of "isms" and "cults" will never be settled in the United States, so far as the practice of medicine is concerned, until both the profession and the public acts on the proposition, intellectually and legally, that whoever holds himself prepared in any manner to diagnose or treat disease thereby offers proof that he has had a minimum standard of training in the fundamental subjects of anatomy, physiology, pathology, bacteriology, chemistry, etc. This would guarantee a correct basis of a working knowledge of the human body, and with this as a foundation on which to build, it would make no particular difference whether the licentiate chose to specialize in medicine, surgery, osteopathy, chiropractic, or Christian Science. In other words there could then be no more objection to a licentiate specializing in any one of the methods of diagnosis and treatment named than could be maintained with equal vigor concerning specialization in orthopedic surgery, physical therapy, or the treatment of psychic disability. By this method the sick laymen could choose his own particular kettle of fish. The science of medicine in all its phases would be applied by men properly grounded in diagnosis and treatment, and the medical profession would have discharged its obligation as sponsor of individual and national health by guaranteeing an irreducible minimum of scientific preparation.

This kind of evolution must come from within the profession outward. Otherwise the public will never be convinced that no selfish motive prompts the action of the medical profession.

Dr. Frothingham implies this very forcibly when, in speaking of osteopathy and chiropractic, he said:

"It has also been attempted to show that these professions can in no way replace the established facts of medical science; and that those using these methods of treatment should have the same general knowledge of medicine that is required of regular physicians, in order to safeguard the individual and the public health."

It is contended, in view of what has been said, that if the American Medical Association, the largest organization of medical men in the world, or the Southern Medical Association, which now ranks second in size, earnestly undertakes the achievement of this much needed reformation in licensure, the hearty cooperation of the medical profession, the better men of the other branches of the healing art, and the general public can be secured without serious difficulty.

It is gratifying that in some sections radiologsts are undertaking the job of incorporating questions in roentgenology in the examination for license to practice medicine. Dr. Menville states that in Louisiana this is being done now. This is certainly a move in the right direction because roentgenology as a diagnostic aid and therapeutic agent is used quite extensively in every village and city throughout the nation. Its potentialities are becoming more evident every day, for which reason a working knowledge of radiology should be provided every physician.

Introducing Dr. Anonymous

IF you have tears, prepare to shed them now." Will Payne in "The Love of Quacks," running in the lead in The Saturday Evening Post of July 8th, provides a happy introduction.

Let him speak:

"You start down town chock-full and running over with a sense of well-being. Certainly you then want to believe that your body is a strong, dependable, automatic machine. As for indigestion, insomnia and all other bugaboos, you defy 'em to touch you! But something happens. A reckless criminal, traveling north, attempts to take a sharp turn in the road at twenty miles an hour just when you, conservatively driving south, attempt to take the same curve at the same speed. The collision rips off your mudguard. Or the trolley breaks down, delaying you forty minutes. Or an imbecile going up the station steps in front of you pokes his umbrella into your eye. Your nerves are as healthy as they were before, but they begin registering violent protests and a busy little dramatist in your skull sets the stage for a tragedy to which the whole town is invited.

"At any sharp, disagreeable disturbance the ill-bred little ego begins yammering for help and sympathy from all the world. You sympathize with yourself and sort of imagine all right-minded people as sympathizing with you. Sympathy is pleasant. So if the disturbance is prolonged you begin to find a satisfaction in your misery. When Hamlet moaned, 'O, that this too, too solid flesh would melt!' a conceited little devil on the other side of his brain was saying, 'That's a corking line, and I must be a very interesting, unusual person or I shouldn't be having these feelings!'

"There is plenty of up-to-date scientific testimony that imagining oneself ill is a quite popular pastime. For one thing it is a way of shirking and securing tender consideration from one's family and friends."

This sort of an introduction is quite in harmony with the conclusion drawn by Dr. Anonymous. His own words:

"The last and most important function of the physician is still his art, *which consists largely in the emotional relationship he must bear toward his patients.* In this all good doctors, from Hippocrates to Osler, have been proficient. This is in its nature antipathetic to the scientific attitude."

Certain words have been italicized for the purpose of suggesting the characteristics of the man and the propulsive forces inducing the trend of his thought.

If one were to follow the line of reasoning used by Dr. Anonymous to its logical and inevitable conclusion he would most certainly flounder on the proposition that the physician who could shed the most copious tears at the slightest brush with malignancy in any of its hideous forms, or could prattle the silliest nothings to women suffering the travails of childbirth, would surely become an illustrious figure in medical science, and a veritable tin god on wheels among men. But that sort of a picture does not, either in fact or theory, coincide with what history tells us about such men as Hippocrates and Osler. It is highly probable that neither Hippocrates in his clinical researches, nor Osler in his studies of smallpox, cerebral palsies of children, chorea and choreiform affections, abdominal tumors, angina pectoris, and cancer of the stomach, ever suffered from the morbid hallucination that their emotions would outweigh their scientific findings when tested in the scale of human accom-

plishment by future generations. And judging from the measure of esteem in which both these men were held by the people who lived with them, and whose illnesses were treated by them, it is incompatible with common sense to say that their humanities were either "antipathetic to the scientific attitude," or conversely, in the face of the records, that they achieved nothing of scientific value.

It would be interesting to know, for instance, how Dr. Anonymous reconciles such a conclusion with respect to outstanding figures in the history of medical science with the statement:

> "The more heavily the physician leans upon the science of the study of disease, the more he is likely to neglect facts that might be directly and simply determined without an imposing and confusing array of modern gimcracks.
>
> "The physician should be venerated not for supernatural knowledge or scientific acumen, but for his understanding of our ills and troubles, for raising his patients' morale, and, last for applying, as a technologist, the therapeutic discoveries furnished him by the small group of scientists who actually study disease."
>
> "The function of the medical practitioner is to cure disease."

And withal, not a word of explanation as to how the research worker whom he chooses to designate as the only true scientist can hope to function intelligently, locked in his laboratory and without knowledge of either the causes inducing the pathological condition under observation, the symptoms following its incipiency, or the results at various stages of its duration.

Nor is any attempt made to indicate how the physician, strictly technologist, can accomplish his function of curing disease without sufficient "scientific acumen" to understand the therapeutic agencies at his disposal and apply them according to scientific findings for his patient's welfare.

It is inconceivable that the research worker can be expected to set up a sort of multiplication table, a few problems in addition, subtraction and division, to cover every pathological condition which exists. And likewise it is hopeless to expect that the practicing physician could comprehend such a complex system even if it were possible to set it up, without pretty intimate scientific knowledge. Any one doubting this can demonstrate it to his own entire satisfaction by asking the next doctor he meets on the street to solve in his head offhand some simple problem in trigonometry or advanced physics.

So far as the practising physician is concerned it must be agreed that he cannot become a master of all the sciences which contribute to the science of medicine and find expression in the public health through its ministrations. For that reason, he shall have to become, as he is rapidly becoming, a technologist of applied science. Since the field is so large, the physician who attempts to reach proficiency in the technology of which Dr. Anonymous speaks, finds it essential to confine his efforts to a single subject—to specialize—and Dr. Anonymous on sober second thought must find himself in the peculiar predicament of the dog who tried to eat himself—the tail and the hind part could be accomplished, but the head,—well that was a problem to conjure with.

Perhaps Dr. Anonymous is mystified by a change in public sentiment—a change possibly from the ridiculous to the sublime. Hero worship no longer stands as the *summum bonum* where life and health are at stake. Magic and mystery at the sick bed have been supplanted by scientific methods. And while science, in all humility, makes no pretense of having mastered the universe, thinking men and women accept it as a great advance over the hocus-pocus procedures of the magic healers of other days.

It is against all this Dr. Anonymous inveighs. His opening statement sounds like the swan song of a broken romance; it is tuned to the funereal march of those who only chant of the golden days of long ago. It is one of those attempts to excuse sincere effort in the present to achieve something worth while because of the incomparable attainments of the past.

These are his own words:

> "*One of the most distressing tendencies in American medicine is the decline of the old-fashioned general practitioner, and his replacement by the modern so-called scientific physician and group doctor.* The doctor is rapidly losing his important role of comforter and friend; he is no longer considered to be privy to the secrets of black magic or to derive his healing powers from intimate acquaintance with gnomes, sprites, devils, or deities. He is venerated, instead because of the growing belief that he is one of the chosen disciples of the new god of science."

In order to get a proper understanding of the decline which seems so grievous to him another excerpt from Dr. Anonymous' pen is interpolated here:

> "The quarters occupied by these associations of experts are the very antithesis of the untidy, dusty, modest sanctum of the old-fashioned 'doc' of other days, so charmingly sketched by Opie Read:
>
> 'In this professional hut there was only one window, the glass of which was dim with dust blown from the road. The furnishings of the office were less than modest. In one corner a swayed bed threatened to fall, in another a washstand stood epileptic on three legs. Nailed against the wall was a protruding cabinet, giving off sick-room memories. The village druggist, compounder of essences of strange and peculiar 'yarbs', might have bitter and pungent medicines, but old doc, himself an extracter of wild juices, had discovered the retching secret of the swamp. To go into his office and come forth with no sign of heaving was a confession of the loss of smell. Sheep-shearing fills the nostrils with a wooly dullness, but sheep-shearers could scent old doc as he drove along the road.' "

Compare all this if you please, with his own description of the "distressing tendencies" which make "the services of these expert super-doctors, for all the free work done for the poor, accessible in the main only to persons well endowed with worldly goods," thus placing the rank and file in a position where they "must be content with the ministrations of the more humble practicing physician, who becomes less and less the idealist of the old days, *and who now represents the mediocrity whose lack of ability or personality makes impossible his attainment to the dignity of the specialist*":

> "Not so the offices of the modern group of specialists. Their suites of rooms are situated in magnificent office buildings. Frequently edifices of many stories are devoted to the housing of collections of stylish doctors. The central waiting-room bears little suggestion of medical affairs. It is fitted faultlessly in expensive and luxurious antique furniture. It has that 'subdued air of elegance and refinement' much sought after by those of our commercially successful countrymen who wish to shed their pristine vulgarities. Its walls are hung with portraits of famous physicians. Upon a central library-table repose neatly arranged copies of the better and more sober type of American per-

> iodicals, and there is a noticeable lack of the more vulgar type of journals that diverts the moments of waiting in even the best barber-shops. Around the walls are arrayed bookcases, garnished with fat medical tomes and with endless ranks of bound volumes of medical periodicals.
>
> "The place is presided over by a businesslike, yet discreetly sympathetic, being, usually in a uniform suggesting that of a nurse, who combines the function of reception committee with that of telephone operator and maker of appointments. The remainder of the suite, which includes consultation and examining-rooms, minor operating-room, laboratories, ateliers for radiography and photography, has the same air of scientific austerity, of efficiency, elegance, cleanliness, and expensiveness.
>
> "It will be clear that the maintenance of an institution of this type is to be supported only at a formidable cost. The salaries of the staff and of such coadjutors as dentists, laboratory men, radiographers, nurses, technicians, bottle-washers, librarians, office girls, telephone operators, and charwomen add to the immense amount necessary for rent and equipment."

It is extremely difficult to imagine a more inane discussion of an important subject. To mention it is to dignify it far beyond anything it merits. But it affords a wonderful illustration of the fact that until the medical profession, through its recognized organizations, provides for publication sensible material on the relation of medical science to public health, stuff like this, emanating from various members of the profession, will find its way into the press. Not often, it is true, will such ridiculously reasoned and written papers be given space in reputable publications; but there are always yellow sheets aplenty which thrive on morbid propaganda, and in a case of last resort to be given audience there is better than never to have appeared in print at all.

Perhaps Dr. Anonymous' intentions were good. Perhaps too he had a just criticism concerning some one or more particular members of the medical profession who have outstripped him in professional attainment or business sagacity. But if that be the case, it is extremely unfortunate he did not choose his words more wisely and confine his discussion to the particular evils sought to be eradicated. Certainly, the medical profession is not one hundred per cent pure. If it were it would be too good for a human world. And just so long as doctors remain human beings, just that long will the profession suffer the consequences of the devilish performances of a small percentage who trample under dirty feet the ideals and obligations of as noble a profession as has ever been known in the history of mankind. This is not an attempted justification; it is simple recognition of an unalterable fact. The writer does not know how to change it. If Dr. Anonymous has any real suggestion to make he may be sure of recognition as one of the few immortals.

Foundations of Science

ANY true scientist will admit that the sole ultimate purpose of all science is the promotion and preservation of human health and happiness. The distance both in space and time between the particular thing the scientist accomplishes in his laboratory and the point at which he or some other person applies that result in order to change individual habits and social customs into more healthful and happy channels, or thereby seeks the rejuvenation and restoration of debilitated organisms,—that distance may be long and tortuous, and not easily traced. But in the last analysis, one is pretty sure to find if he looks closely enough, that whatever advance has been registered under the name of civilization or human progress, be it economic, social or physical, can be directly attributed to the accomplishments of those investigative minds seriously devoted to inquiry concerning man's relation to the universe.

Science and scientific method, in all the various functions it has catalogued and charted, constitutes man's greatest achievement. It seems perfectly sound, then, to lay down the proposition that in the great study of human life and health, so that all things may be coordinated and correlated to produce the utmost in both, will be found certain fundamental factors which are common elements to all men everywhere, and that these properly related and studied may prove to be the foundations of all science. In this way, it seems possible that through scientific effort men may lay hold of that master key which will open the door to that abundance of life referred to by Christ.

Unquestionably, these thoughts are beginning to grow in the minds of men. There is more universal interest in, and appreciation of the value of scientific achievement today than ever before in the history of the world. The quest for health and happiness has become a matter of first importance whether one arbitrarily limits his observations to some particular phase of the world's activities or studies a cross-section of the whole conglomerate mass. And attempting to visualize the future, it seems almost certain that the years just ahead will be registered in the records of human achievement as the scientific age.

If these general observations are sound, an effort to build a fair and sensible understanding of the foundations of science ought not to be utterly useless.

A few random quotations will prove interesting and instructive. They have been taken from current literature. They certainly indicate the trend of men's thought, and point conclusively to united desire to determine a starting point for all human relations,—one or two simple, absolute, fundamental principles which will stand the test of common sense and afford a rational explanation of the thousand and one things every man and woman intuitively knows he must do at his peril regardless of his eternal why?

In an article which appeared in The Saturday Evening Post of July 8th under the title "Food, Fuel and Smoke," Floyd W. Parsons makes this significant statement:

> "From the revolving electron of the tiniest atom of matter to the blazing center of our solar system, the sun, practically everything is classified, if not valued, in terms of energy potential."

The same thought, detailed a little more, is to be found in a chapter headed "Solidified Sunshine," found in a book recently written by Edwin E. Slosson called "Creative Chemistry:"

> "All life, and all that life accomplishes, *depend upon the supply of solar energy stored in the form of food.* The chief sources of this vital energy are the fats and the sugars. The former contain two and a quarter times the *potential energy* of the latter. Both, when completely purified, consist of nothing but carbon, hydrogen and oxygen; elements that are to be found freely everywhere in air and water; so when the sunny southland exports fats and oils, starches and sugar, it is then sending away nothing material but what comes back to it on the next wind. What it is sending to the regions of more slanting sunshine is merely *some of the surplus of the radiant energy it has received so abundantly, compacted for convenience into a portable and edible form.*"

Without exactly knowing why, everybody realizes that life in the higher forms which constitute mankind and are useful to it neither flourishes nor exists without plenty of

sunshine. The child that is confined to the house too closely becomes first puny, second, wan, and third, sickly; and for a vigorous demonstration of the value of solar energy consult the average agriculturist about his crops during a late spring under murky skies. This may sound elemental and simple, but after all, practically all the complexities of life as it is usually lived have been introduced by man himself; for which reason it seems essential, in considering this subject, to get back to first principles.

Now listen to Professor J. Arthur Thomson, of the University of Aberdeen, Scotland, whose "Outline of Science" is one of the most lucid and fascinating treatises to be found in literature, past or present:

> "Most people have heard of 'atomic energy', and the extraordinary things that might be accomplished if we could harness this energy and turn it to human use. A deeper and more wonderful source of this energy has been discovered in the last twenty years, but it is well to realize that the atoms themselves have stupendous energy. The atoms of matter are vibrating or gyrating with extraordinary vigor. The piece of cold iron you hold in your hand, the bit of brick you pick up, or the penny you take from your pocket is a colossal reservoir of energy since it consists of trillions of atoms. To realize the total energy, of course, we should have to witness a transformation such as we do in atoms of radioactive elements * * * ."
>
> "One of the fundamental entities of the universe is matter. A second, not less important, is called energy. Energy is indispensable if the world is to continue to exist, since all phenomena, *including life*, depend on it. * * * ."
>
> "The primary reservoir of energy is the atom; it is the energy of the atom, *the atom of the elements in the sun, the stars, the earth, from which Nature draws for all her supply of energy.* * * * ."

With these facts in mind, it is easy to explain the intense interest in things scientific. It is easy to understand the fascination and the hope men find in the study and application of the science of radiant energy. For life is a perpetual conquest. Health and happiness are its goal. These are not possible without substantial achievement and at least a meagre understanding of those forces of life man adapts to his use every day,—by which man in fact actually lives. Science seems to be the only agency known to man which offers any promise of that rational knowledge of phenomena on which certain dependence can be placed in calculating the best method of attaining his desires. Thus, with a record of useful service, a language that is common to and comprehensible by all men, it is but natural that in the great swirl of unattached thought which has pervaded the world these past few years, men should reach out for the only stabilizing influence they see.

Since all life is dependent upon or an expression of the one great source of radiant energy which man knows,—indeed one might without fear of being considered utterly foolish ask whether the two things we call radiant energy and life are not actually one and the same thing,—it may be logically stated that the science of radiant energy is really and in fact the master science, and that the principles established in its study actually form the foundation of all the other sciences. As proof of this, it is suggested that the thing which makes it possible for the scientist, be he chemist, metallurgist, or other, to change inorganic forms of life to organic, and vice versa, is that knowledge of radiant energy which enables him to separate the electrons constituting the particular thing under his hand and to rearrange them according to his will, that is, take them from one compound and build them into another more peculiarly adapted to man's use.

The Future of Radiology

STARTING from the proposition that all life in its final analysis really is, or most certainly depends upon, radiant energy, it becomes important to determine which particular science the public can charge with responsibility for the continued investigation and beneficial application of those fundamental principles thus far discovered in the study of radiant energy. That is to say, the science of radiant energy has become of such importance that in justice to its votaries recognition should be accorded it as a noteworthy member of the scientific family. By the same token, it also becomes desirable to know whether there is already in existence any especial body or organization of scientists who can be depended upon to prosecute diligently and with fitting vision, the science of radiant energy as a possible agent for the promotion and protection of individual and national health.

This is a peremptory challenge to Radiologists, and calls immediately for a statement, in comprehensive terms, concerning the purposes of those men who espouse it. The science of Radiology, viewed in its proper relation as a factor of the public health, is asked to give an account of itself so that, generally speaking, the public may know what to expect of Radiologists, and in turn, so that Radiologists everywhere may know definitely what the public demands of them.

Therefore, stated as concisely as possible, an inclusive definition of the science of Radiology may be given as the study and application of radiant energy in all its forms for diagnostic and therapeutic purposes, confining ourselves to the medical viewpoint for the moment.

To elaborate a trifle, the science of Radiology should comprehend investigation into the curative and preventive powers of radiant energy and methods for applying them to individual and national health.

The necessity for examining briefly the present scope of Radiology in order to determine its possibilities becomes at once apparent.

According to G. W. C. Kaye, O. B. E., M. A., D. Sc., who addressed the section of electrotherapeutics, Royal Society of Medicine in February of the present year at London during the "Congress of Radiology and Physiotherapy," there are sixteen known octaves in the spectrum of radiant energy given off by the sun, and "as yet the radiologist has only turned about three octaves of these to account."

Surely this will suffice to indicate the possibilities of the science of Radiology, particularly if one compares the relative position of these three octaves in the spectrum with the wide range of electro-magnetic wave lengths familiar to every physicist. The measurement of the wave lengths of ultra violet light, x-rays, and the gamma rays of radio-active substances such as radium will be stated in Angstrom units. An Angstrom unit is 10^{-7} mm.

Ultra violet	4000 to 200
X-rays	500 to 0.06
Gamma rays	1.4 to 0.01

These are Dr. Kaye's figures. Some physicists contend that the range of ultra violet runs from 1800 to 8000 Angstrom units. But no attempt to harmonize those differences of opinion is essential to this consideration.

According to an American physicist of considerable note, the range of the field of electro-magnetic waves may be stated for comparative purposes with the foregoing:

25 ft. to 25 miles	wireless
1/1,000 ft. to 1/35,000 miles	heat
1/25,000 ft. to 1/70,000 miles	light
1/70,000 ft. to 1/125,000 miles	ultra violet
1/250,000,000 ft. upwards	Inf. x-rays

True, science has not yet devised methods for the clinical application of this wide range of radiant energy. But when it is remembered that the science of radiant energy as such is only about thirty years old, the phenomenal progress already made is apparent.

There is, however, one outstanding proposition that must be patent to anybody giving the subject anything like serious thought, and that is, that there is magnificent opportunity for collaborated and coordinated research by physicists and radiologists in the field of radiant energy. This is absolutely fundamental if the clinical aspect of the problem is to receive proper consideration and the therapeutic value of radiant energy be determined to the ultimate.

Bearing in mind the wonderful accomplishments already achieved in connection with the three segments of the spectrum now in use, as well as the potential promise their further investigation and application imply, one is compelled to say that failure on the part of physicists and radiologists to fully coordinate their labors in sustained and wholehearted manner will be nothing short of criminal neglect of an imperative duty. This too, without regard to the potential possibilities of the thirteen remaining octaves in the spectrum of x-rays whose clinical application should prove one of the most tantalizing and profitable tasks ever undertaken by man.

These are the thoughts which stir a man's blood when he tries to outline in visual form the future of Radiology. These are the thoughts which move a man to vigorous language when he sees indefatigable workers here and there sketching into the background of his picture suggestions of the applicability of radiant energy for stimulating subnormal tissues as well as destroying abnormal tissues. And without straining either eye sight or mental vision he begins to ask the pertinent question whether, in the no distant future, radiant energy may not be successfully applied as an immunizing agent?

Surely such a vision of the future of Radiology is not wholly beyond the realm of reason. When scientists agree that all life, and all that life accomplishes, depends upon radiant energy,—when scientists agree that disease in its various manifestations is but the breaking down of cells whose energy has been dissipated,—when scientists bring forth indisputable evidence of organ stimulation by the application of radiant energy, be it x-rays or ultra violet light,—and when radiologists themselves demonstrate every day the restorative powers of radiant energy by obliterating malignant growths and producing normal tissues in their stead,—when all these things are a matter of common scientific knowledge, is it too much to say that the science of Radiology commands respect as one of the great potential forces in national health and at the moment offers substantial ground for hope that the forces of all life may yet be scientifically understood and applied?

American Roentgen Ray Meeting

THE attention of our members is directed to the coming meeting of the American Roentgen Ray Society, to be held in Los Angeles, California, September 12 to 17, 1922.

At the St. Louis meeting of our Society, President-elect Stewart of the American Roentgen Ray Society extended to all members of the Radiological Society of North America a hearty invitation to attend the Los Angeles meeting. The undersigned begs to second this invitation, and to assure all that in addition to the profit derived from the scientific sessions, this opportunity would make a splendid vacation for those who have not yet visited the coast.

To those who are not familiar with the California climate in September, it might be well to say that the days are usually warm and the nights cool, but to reassure those who might be timid of the heat, heat prostration is unknown in California. In other words, the heat is not nearly so enervating as that of an ordinary hot summer day in the East.

ALBERT SOILAND, M. D.

Russell Herbert Boggs, M. D.

IT was with surprise and grief that we learned of the sudden death of Dr. Russell Herbert Boggs which occurred at his home a short time ago. It will be recalled by the members of the Radiological Society that he was present at the summer meeting in St. Louis and that he seemed in his usual good health and good spirits, so his demise came as a shock to all of us.

It is fitting there should be recorded here some of the things of his life which bespeak an extraordinarily brilliant career. He was one of the leading members of the American Roentgen Ray Society, one of the organizers of the Pennsylvania Roentgen Society, a member of the Philadelphia Roentgen Ray Society and a member of the Radiological Society of North America. Not only did he hold membership, but he was very active in all of these organizations, as well as in the American Medical Association.

There are few men who have contributed so much to the literature on treatment of malignant disease as has the late Dr. Boggs. His work remains as a memorial to his industry and vision. We shall miss him at future meetings of the Radiological Society of North America and there is left a niche which no one can fill. His work is his tribute and many whom he has helped to a larger and more useful life will bear testimony to his professional ability and attainments.

We extend our sincere sympathy to the wife whom he was compelled to leave in the prime of his life.

Annual Meeting

IT is imperative that hotel reservations for the annual meeting December 4th to 8th, 1922, be made immediately. Those who contemplate attendance should write at once directly to Hotel Statler, Detroit, Michigan.

Detroit is centrally located and easy of access from all parts of the United States and Canada. From present indications the attendance will be larger than at any previous meeting of this society. Bear in mind that action at once is essential.

DEPARTMENT of TECHNIQUE

Essentials in the Use of Higher Voltage in X-Ray Therapy

EDWARD L. JENKINSON, M. D.
Chicago, Illinois

DURING the past ten months the subject of x-ray therapy has been the main topic at all meetings, both state and national. All other subjects have been displaced for the time being at least, and most of the time has been given to the subject of higher voltages. It is no longer sufficient to state the spark gap used. The potential must be definitely measured. For measuring higher voltages accurately, a sphere gap is used, constructed according to the standards of the American Institute of Electrical Engineers. The sphere gap must be placed in the high tension circuit as near the tube as possible. By this method the peak voltage at the tube is definitely measured.

With the higher voltages the subject of protection to the patient, the operator, and persons adjacent to the department is of importance. During the past four months, numerous experiments have been carried out with special reference to protection. By the use of dental films and the electroscope the following conclusions were reached. The use of a lead screen, regardless of the thickness, is inadequate. The idea that the rays travel only in a direct line does not apply when using a voltage of two hundred thousand or more. Secondary radiation is given off by the walls and all objects in the room. The primary rays are deflected. It is, therefore, imperative that the operator be entirely enclosed in a lead booth—this point must be emphasized. The lead must be at least one-quarter of an inch thick. One quarter of an inch of lead will supply ample protection for two hundred thousand volts. For the voltages above two hundred and twenty thousand, three-eighths of an inch should be used. It is not sufficient to line a booth with lead, as a large amount of secondary rays which are harmful to the operator are given off. By covering the lead with pulp board or leather the secondary radiation is absorbed, and ample protection is afforded.

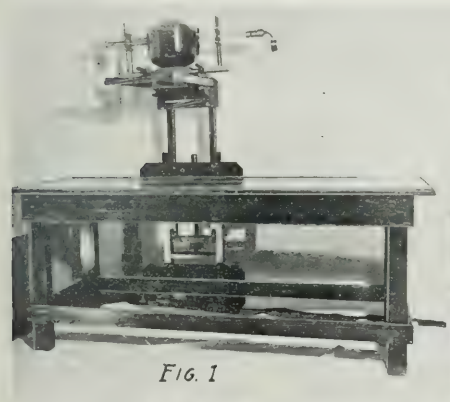


FIG. 1

FIG. 3

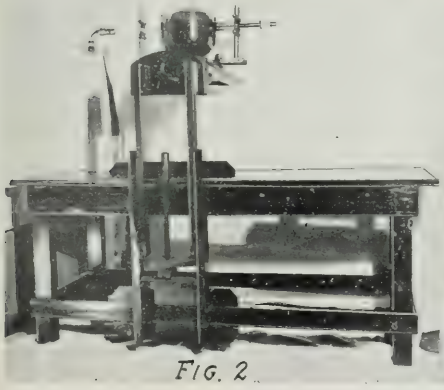


FIG. 2

FIG. 4

Figure I.—Lateral view of table.
Figure II.—Posterior view of table.
Figure III.—End view of table, showing tilting of tube.
Figure IV.—End view of table, showing lateral tilting of tube.

When the large equipment at St. Luke's Hospital was installed it was, for various reasons, impossible to enclose the operator. A large lead shield with wings on each end was constructed.. It was found after some experimenting that the films on the wall immediately adjacent to the tube, protected by one quarter of an inch of lead were not exposed after one hundred minutes at two hundred thousand volts with five milliamperes. The films placed a couple of feet behind the wall were very black after the same exposure with the same voltage and milliamperage. This we decided was due to secondary radiation and to deflected primary rays. The primary radiation was probably deflected by the walls of the treatment room. The secondary radiation, I believe, was given off by all objects in the room. Following the above experiments we decided that adequate protection could not be obtained by any kind of an open booth. Lead covered doors were placed at each end of the booth and the roof was entirely covered. The above experiments were again carried out and we found that films in certain parts of the booth were still exposed. Careful examination revealed a small triangular opening not covered by lead. This open-

ing was not in the line of the direct day. The hole was immediately covered with a quarter of an inch of lead and the experiments were repeated. We then found that ample protection was given the operator.

Great care must be used in selecting the room for x-ray treatment. If possible it must be on the ground floor with no basement below. If a basement is below the treatment room ample protection must be provided for the occupants of the basement. The floor should be covered with at least one quarter of an inch of lead. The room immediately above the tube should also be considered as sufficient rays are given off the top of the anode to do great harm. We found that films placed in the room above the tube (through an air space of eighteen feet and a sixteen inch concrete floor) were definitely exposed in thirty-five minutes with two hundred thousand volts using five milliamperes. To guard against accidents and legal proceedings it is advisable to place lead on the ceiling of the treatment room. It is not sufficient to lead the walls of the treatment room head high. The entire room must be enclosed. The same thickness must be placed on the walls of the treatment room as used in lining the booth.

Using the electroscope with an air discharge of five days it was found that through an eighth of an inch of lead, the instrument was discharged in one minute and thirty seconds. It was practically impossible to charge the electroscope while the tube was excited. After the addition of an eighth of an inch of lead, the electroscope was not influenced when the tube was active.

The possibility of using a brick wall as protection against short waves of x-ray was very thoroughly investigated. It was found that through a fourteen inch brick wall the electroscope was discharged in twenty minutes. Dental films placed on the wall were fogged at the end of four hours. Through two fourteen inch brick walls and an air space of nine feet, the electroscope was not affected. Dental films likewise showed no fogging. Taking the above experiments into consideration, the following conclusions were reached:

1. One quarter of an inch of lead is the minimum for protection against two hundred thousand volts.
2. The operator must be entirely enclosed in a booth lined with one-quarter of an inch of lead.
3. The treatment room must be lined with at least one-quarter of an inch of lead.

For the comfort and well being of the patient, the treatment room must be well ventilated. The aerials should be of copper tubing at least seven-eighths of an inch in diameter. The joints should all be rounded, which tends to lessen the amount of corona. The use of wooden cradles placed over the patient adds greatly to comfort. The cradles can be covered with lead. A portal through which the patient can be treated is cut in the lead.

The older tube stands and tables are unsatisfactory for present day therapy because the metal parts are too close to the tube and serious accidents are very likely to occur. The proper placing of the filters is of great importance from an economical standpoint. If the filters are placed less than three inches from the tube a puncture usually occurs. Therefore, from an economical standpoint it is very essential to have more than three inches of space between the bowl of the tube and the filter. We have for our use in therapy a wooden table with a wooden tube stand attached. In the making of the table no metal was used. The tube stand is very easy to operate, and any angle or position can be obtained. An electric push button is placed in the patient's hand by which she can signal the operator. (Figures 1, 2, 3 and 4 show different position of the table and tube stand).

Every treatment should be supervised by the roentgenologist (physician) in charge. The leaving of treatments to technicians is bad practice. A thorough knowledge of anatomy and pathology is necessary in roentgen therapy. It is not sufficient to place the tube above the patient and throw the switch. There are other requisities. The tube must be accurately placed with reference to the pathology. The glands and areas in which metastases are prone to occur should also be radiated. Only a comprehensive knowledge of anatomy and pathology makes good roentgen therapy possible.

The placing of the filters and measuring the target skin distance is the duty of the roentgenologist. The roentgenologist should see that the filters are *in situ*, and sign the treatment card to that effect. The measuring of the target skin distance may, to the average individual, seem of little import; one or two inches may seem of little consequence, but after working with the iontoquantimeter with reference to the skin depth dosage, I have been impressed with the importance of the above factors.

In our work we found that changing from twenty to twenty-two inches caused a difference of 4.5% at a depth of ten centimeters. If four areas had been anticipated, the tumor mass would be receiving eighteen per cent less radiation at twenty inches than at twenty-two inches. Eighteen per cent in some cases may be the deciding factor. We can readily see how important it is to be accurate. After establishing the ratio of skin to depth dosage at a certain skin distance it is imperative that the factors be constant if results are to be obtained.

Before treating a carcinoma of the uterus or of the breast, the thickness of the part should be measured. We have found that through an abdomen measuring 14.5 centimeters, 32.5% of the skin dose was delivered through the posterior surface. Immediately we can see that two portals will not give favorable results. If we give an erythema dose anteriorly 32.5% will be delivered to the skin posteriorily. If we repeat the dose posteriorly the skin front and back will have received 132.5%. With this knowledge we can see that at least three portals of entry must be used. We can safely give 70% of the erythema dose in front, which will deliver 35% at a depth of ten centimeters and 22% posteriorily. The same dose may be repeated posteriorly; 70% will be delivered at ten centimeters and the skin will have received only 92%. To build the dose at ten centimeters, up to 100 to 115% portals laterally may be used. By this method it is possible to get 100% of the erythema dose at a depth of ten centimeters and still preserve the skin.

There is a considerable difference in the amount of obstruction that certain parts of the body offer to the rays. Take for example a chest that measures twenty centimeters through, and an abdomen also measuring twenty centimeters. What will be the difference in the depth doses? Through the chest we were able to deliver, at twenty centimeters, 23% of the skin dose. Through the abdomen, however, only 13% could be delivered at a depth of twenty centimeters, showing a difference of about 9.5%.

In obtaining the above data, paraffin and water phantoms were used. The paraffin, when compared with the human showed a difference of one in fifteen, or approximately 7% less than the body resistance. The water phantom was about 99% accurate. The measurements through the abdomen and chest were made on patients and this is the most accurate method.

NEW EQUIPMENT

The Victor Ultra Violet Hospital Unit

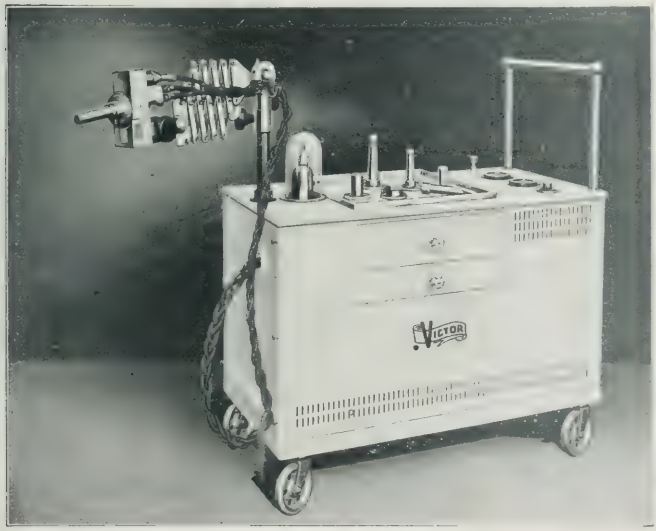
TO those who have devoted studious attention to ultra violet therapy, there must have been felt an obvious need for an equipment that embodies modern engineering advances in a compact, mobile form useful for hospital, clinic and cubital office practice. This is realized in the newly introduced Victor Hospital Unit, in which the distinguishing features may be summarized as follows:

(a) Modern "Uviarc" tungsten anode quartz tube, water cooled type.

(b) Automatic water-circulating device, including an amply large tank, a motor driven pump, and a cooling dome, the water circulation beginning with the throw of the operating switch.

(c) Compact assembly of equipment into an efficiently proportioned mobile cabinet holding built in drawers that accommodate a complete set of applicators and accessories.

Remembering that the energy emitted by the Water Cooled outfits is of dominant bactericidal utility, it is appreciated that this unit is particularly fitting for the clinical use that it is intended to supply. It interests the specialists who have infection pathology to treat; urologists, gynecologists, ear nose and throat experts, orthopedic surgeons, general surgeons, dermatologists, dentists.



Perhaps the most significant feature of the unit is resident in the fact that it represents the first American innovation in the supply of modern ultra violet equipment created in response to the requisites dictated by intensive research in three fields of endeavor:

(1) Biophysical research.

(2) Critical analysis of clinical need.

(3) Preeminent engineering acumen.

Biophysically, the energy derived from the Water Cooled equipment, as compared to that derived from Air Cooled equipment, has been found to manifest certain qualities that have never before been ushered into medical use and this new unit embodies the essential electrical engineering factors necessary to insure the maximum yield of these peculiarly endowed rays. It is difficult to imagine an energy more uniquely adaptable than ultra violet in its extensive horizon of clinical applicability; and, offered for use in a manner that reflects the combined intellect of an army of modern workers, it is fair to predict that there will be a new era of therapeutic possibility stimulated by this latest device to supply, with maximum clinical efficiency, the most chemically potent region of the electromagnetic energies.

Buck X-Ograph Cassette

THE Buck X-Ograph Company of St. Louis is introducing a new cassette especially adapted for use with plate tunnels and Potter Bucky Diaphragm. The outstanding thought in its construction was to secure good contact without the assistance of the weight of the patient bearing down on the front of the cassette.

Since the advent of the Potter Bucky Diaphragm there has been a great deal of talk regarding the use of various kinds of flexible pads, etc., placed between the cover of the cassette and the intensifying screens in order to secure proper contact between the screens and the film. The purpose of such pads was to cause the screens to conform to the curvatures of the sheet aluminum front of the cassette, which in most instances was inclined to bulge outward away from the screens.

The Buck cassette has a sheet aluminum front drawn by machinery and clinched over the frame in such a manner as to make it absolutely rigid. The cover of the cassette is then manufactured with ribs running both lengthwise and crosswise, which serve to strengthen the cover, making it also rigid. And by placing the screens between the two flat surfaces formed by the sheet aluminum front and the cover it does not require any unusual pressure or pads of any kind in order to get even contact between the screens and the film.

The re-enforcing ribs on the back of the cover act as studs to carry the

weight when the patient rests on the cassette, thereby relieving this strain from the stretched aluminum front. This construction makes it possible to produce a cassette which is much thinner.

The edges are perfectly smooth, and although this cassette has leather hinges they are so combined with metal plates as to overcome the disadvantage of the screens grinding together on opening and closing the cassette, all of which are conveniences very much appreciated by the roentgenologist.

New Sweetbriar Intensifying Screen

AN announcement that will be of especial interest to radiologists and others employing intensifying screens, comes from the Sweetbriar Laboratories, Inc., of Pittsburgh, Penn.

Sweetbriar screens have been generally recognized as being free from grain. This result, in the past was accomplished by sacrificing something of speed.

It has been known for some time that the Sweetbriar Laboratories were conducting a long series of research experiments for the purpose of developing a process which would give the usual high result in grainlessness, and at the same time make up the deficiency in speed.

The Sweetbriar Laboratories now authorize the statement that these experiments have developed into dependable processes which produce an intensifying screen that is absolutely grainless without any loss of speed. This statement is made with due regard for the fact that a screen may be so nearly grainless no visible effects appear on radiographs made with it, but that nevertheless there may be just that small amount of grain which obscures fine detail and outlines which should be sharp and distinct. It is stated that pictures made with the new Sweetbriar screen are clear-cut, have wonderful contrast, and at the same time show an amazing amount of detail in both bony and soft tissues.

It will be remembered that in the Fall of 1919 at a meeting of The American Roentgen Ray Society, held at Saratoga Springs, New York, the Sweetbriar Laboratories exhibited a waterproofed intensifying screen. The method then used produced a screen so deficient in speed that the Sweetbriar Laboratories refused to put it on the market. A long series of experiments has perfected this waterproofing process with no loss in speed, and unless otherwise specified by a customer all screens shipped in future will be waterproofed.

New machinery has been installed at the Sweetbriar Laboratories and production on a large scale is now in progress in order to meet the demand.

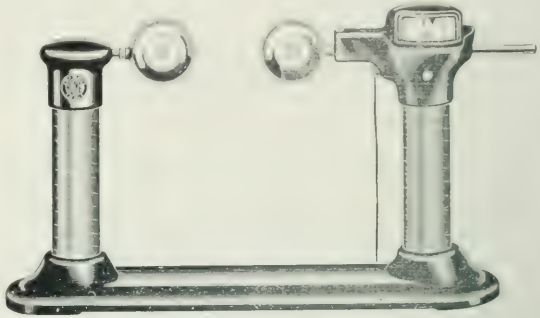
Acme Magnetic Sphere Gap

THE perfecting of the Acme Magnetic Sphere Gap by the Acme X-ray Company of Chicago, has just recently been announced. This gap is something entirely different from the ordinary sphere gap and will no doubt attract much attention among those interested in roentgen work. It is very simple to operate and eliminates all personal error.

When the potential across the x-ray tube is to be measured, a cord is pulled which causes one sphere to move slowly toward the other. Traction is kept on this cord until a spark passes between the spheres. However, it is not necessary to read the gap at the exact instant the initial spark passes, as this gap is provided with a magnetically controlled indicator which is released when the spark first passes and indicates on the scale the point at which this occurs. If one keeps pulling the cord the scale will continue to move, but the indicator will move with it and still show the original reading. One can, therefore, read the gap at leisure, as the indicator will retain its position as long as the cord is not released. As quickly as the cord is released, the ball and indicator both return to their original positions.

The scale has large black figures on a white background and is easily read at a considerable distance. It is calibrated in kilovolts (crest or peak values) in accordance with the present practice.

The gap is arranged for use with the new Acme 85 kv. Corona Proof Roentgen Generator (120 kv. peak value) equivalent to seven and one-half inches, or for use on a circuit of 170 kv. (peak value) equivalent to twelve inches. It can be mounted either on the transformer cabinet or in the overhead system.



This gap fills a very important place because it combines the convenience necessary for fast routine work with the accuracy which is so essential in handling a therapeutic and diagnostic agent of such importance as x-rays—something not heretofore attained.

Liebel Flarsheim Dynelectron

IN view of the increasing use of high frequency apparatus due to the growing recognition of the advantages of electrotherapeutics considerable interest naturally follows the introduction of new appliances such as that designed and marketed by The Liebel-Flarsheim Company of Cincinnati as its Model "P" Dynelectron.

An outstanding feature in the design of this apparatus is the total absence of Leydin jars or salt water solutions, external means for cooling the spark gap, breakable glass condenser plates, and no oil to spill or seep out of the transformer.

In order to overcome the difficulties in operation of spark gap that have been more or less universal, particularly those due to corrosion and oxidation of the points as well as the overheating of the points of the gap, The Liebel-Flarsheim Company has reduced the electrical resistance of the spark gap as much as possible and provided an extraordinarily large radiating surface. Mr. Liebel, President of that Company, says this apparatus can be operated continuously within safe temperature limits twenty-four hours a day if necessary without any injury to the parts of the machine.

While this particular piece of apparatus is designed for electro-coagulation purposes suitable for the requirements of the specialist in Radiology and provides Oudin current and auto-condensation, it is so constructed that a powerful diathermy current can be produced by it.

This is an added advantage in that the value of diathermy in various conditions, such as bone and joint pathology, is becoming quite generally recognized and used.

The Model P Dynelectron is also furnished mounted on a cabinet so that it can be readily and easily moved from one room to another and to different parts of a ward in a hospital. The cabinet is constructed of oak, dark finish; the switchboard of marble embedded in felt. The spark gap is three stage tungsten point, quenched gap.

Modalities — electro-coagulation of very high frequency with sufficient power for all cases. Oudin high frequency current for vacuum or non-vacuum electrodes. Diathermy up to 4000 ma.; auto-condensation up to 1000 ma. Meters are interchangeable, one reading up to 1000 ma. and the other up to 4000 ma.

A full line of accessories is also available.

The New Wappler Junior Horizontal Fluoroscope

FURTHER attempts to eliminate all possible danger in the use of x-ray apparatus are responsible for the development of a new type horizontal fluoroscope by the Wappler Electric Company. Because of its outstanding features of simplicity in construction, efficiency and safety of operation, this apparatus is attracting considerable attention. It must be remembered, of course, that there is some danger of shock, both to operator and patient, when using fluoroscopes in the dark, especially those equipped with small transformers without rectifiers. This being true, this new piece of apparatus would certainly seem to be a decided forward step in the construction of fluoroscopes.

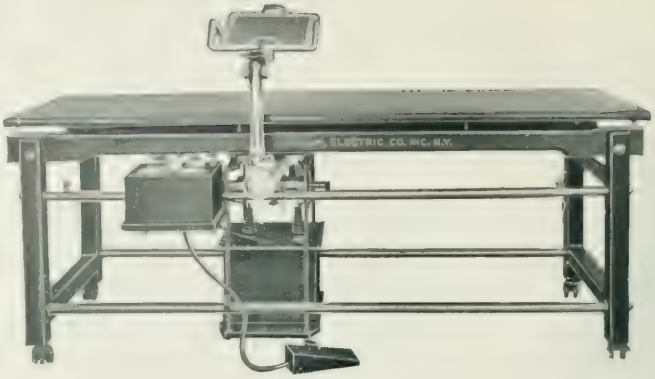
A side view of the Wappler Fluoroscope is shown in the accompanying illustration. It consists of a wooden top table with wooden legs, which latter are strengthened with metal side rails. Between these metal rails, suspended from the shutter carriage, is the transformer and radiator type tube. The high tension terminals are on top of the transformer connecting directly to the terminals of the tube. The shutter carriage runs on ball bearings on the upper rails. These side rails and the metal rods supporting the transformer protect the patient against shock resulting from contact with high tension parts, particularly when the operator accidentally places a foot on the lower rail. The entire arrangement, running with extreme ease, makes it possible to cover the entire table top and thus permits examination of the entire body without the necessity of moving the patient.

The electrical control box equipped with the well known Wappler Stabilizing feature, auto transformer, filament control, switches and pilot light, is mounted on the side of the table; the control device for the shutter and the device for adjusting the screen to various heights from the table top are all mounted on one side of the table so that an extremely easy control and manipulation of the electrical part and the screen are obtained. The inlet connection is made to the control board and the current is switched on with a foot switch. There is, therefore, no high tension current carrying wire or terminal outside of the rails of the table and all possibility of shock or short circuiting to the operator or the patient are positively eliminated.

Another new development in this apparatus is represented in the new type screen holder, which, while fully balanced in every position, is easily adjusted for all possible tilts and movements desirable for fluoroscopic work. For the convenient placing of bed patients or possibly stretchers upon this table, the screen arm can easily be removed or turned to the side so that of all apparatus of this type, this is probably one of the most flexible, most easily adjusted, and safest. The size of the fluoroscopic field extends over the entire length and width of the table and there are no projecting parts. No accessory apparatus is required.

The most distinguishing features of the Wappler Junior Horizontal Fluoroscope are:

1. Absolute protection against high tension shock.
2. Extreme ease of control, operating entirely on roller bearings.
3. Full length and width of fluoroscopic field to enable complete examining of the patient without moving the patient.
4. Complete electrical control of tube current and voltage, independently of each other, and the practicability incident to being able to connect the apparatus to any existing light socket.
5. Improved screen and shutter holder to permit absolutely free adjustment of the screen for all possible conditions.
6. The screen arm removal feature so that operations can be performed on the table without interference of screen arms or other projecting parts of the apparatus.



ABSTRACTS and REVIEWS

A Review and Classification of Bone Sarcomas. James Ewing, M. D., Archives of Surgery, 4:485, May, 1922.

TO designate a bone tumor simply as round, spindle, or giant cell, is quite inadequate to the proper definition. If properly defined, e. g., "osteogenic sarcoma," further designation of cell type is then useful as an indication of the degree of potential malignancy. Such a classification is possible to a considerable extent.

The forms of neoplastic disease originating in bone and bone marrow are classified under the following main heads which are further subdivided: (1) osteoma, (2) chondroma, (3) endothelioma, (5) benign central giant cell tumor and variants, (6) osteogenic sarcoma, (7) myeloma. Pure myxoma is classified under chondroma.

There follows in the original an "outline of the clinical, anatomic. and structural features of some common bone tumors" which covers forty or more pages. In this outline the typical roentgen ray findings are described.

Solitary diffuse endothelioma is remarkably susceptible to roentgen ray and radium but the final outcome of this treatment is not yet established. In these cases amputation should be withheld until its indications are very clear.

Benign central giant cell tumors may be cured by either curettage, roentgen ray or radium, though curettage holds the danger of infection and recurrence is common after this form of treatment. They will respond to x-ray or radium but months of treatment are required with restriction of motion. If of catilaginous origin they "should be susceptible to radium or x-ray" because they are cellular, but this is not definitely claimed by the writer. In uncomplicated giant cell tumors roentgen ray or radium is the treatment of choice—external radiation being preferable.

In general roentgen ray or radium is recommended for myelomas and diffuse endotheliomas but not for osteogenic sarcomas—for these latter extirpation followed by postoperative roentgen or radium treatment is favorably regarded.

Regarding this the writer makes these observations: (1) "It has been shown that it is possible to deliver an effective dosage to all parts of many osteogenic sarcomas when the tumors are accessible from all sides. (2) The histologic changes demonstrated show a slowing of rate of growth of the tumor cells by which they are induced to lay down calcific material or dense hyaline stroma or bone. Hemorrhage and necrosis may be produced with vascular cellular tumors. (3) Cellular tumors without much intercellular stroma may undergo completet resolution and disappear," otherwise the most to be hoped for is sclerosis or ossification of the tumor tissue with cessation of growth. True osteogenic sarcomas usually prove fatal under any form of treatment.

Present results in the treatment of bone sarcomas are far below a reasonable standard. The author believes that the present state of knowledge together with the resources offered by x-ray and radium demands that the whole subject of prognosis and treatment should be reopened. More radical diagnosis, he believes, would lead to less radical treatment—nonoperative treatment is the goal to be kept in view.

As to technique he makes the general observation that no person who is inexperienced should attempt to deal with bone tumors. Proper selection of cases, more careful study of the exact anatomic condition to be dealt with, adopting the agents to the conditions as found, and a judicious combination of surgery with roentgen ray and radium will lead to greater efficiency.

Thesis Upon the Subject of Radiographing the Spine and the Pelvis. H. J. Suggars, M.S.R. (Awarded the President's Prize.) Arch. Radiol. and Electroth. 26:382, May, 1922.

THE details involved in taking radiographs are listed under (a) those to be attended to before the patient occupies the couch, (b) while the patient occupies the couch, (c) those carried out afterwards.

Under the first topic the points which contribute to a good plate, such as care and cleaning of apparatus, tube adjustment, condition of tubes and provisions for the patient's comfort, are taken up. Proper cleaning prevents wear and tear upon nerves as well as machinery. Hints on how to get the focal spot as near as possible to the center of the aperture in the shield are given, and examination and alteration of the resistance of the tube before the patient takes his position is advised.

While the patient is on the couch precision in adjustment of the tubes, correct posing, and exactitude in locating the plate are essential points of good technique. Personality, pads, cushions and sand bags are all factors in producing ease and fixity of position of the patient which in turn are important factors in securing good results.

Beautiful photographic radiographs taken without due regard to the exact relation of the patient and plate are of small value. Posing is the most important factor of all and this and the matter of plate adjustment is gone into in complete detail for radiography of the pelvis and the lumbar, dorsal, and cervical vertebrae.

Details of developing and printing occupy a page. Careful immersion so that the solution flows immediately, evenly and gently over the plate is absolutely essential to desired results. Masking of the plate before printing will secure a white margin, and it is also a means of improving the appearnace of a "lop-sided" radiograph if such is inadvertently made.

Sarcoma of the Long Bones. Jas. W. Gibbon, M. D. Virginia M. Monthly, 49:142, June, 1922.

SARCOMATOUS tumors of the bone marrow are classified by Ewing as: (1) osteogenic sarcoma, (2) giant cell sarcoma, (3) myeloma, (4) endothelioma, the last two forms being rare.

Osteogenic sarcomata are in turn classified as:

1. Fibrocellular or periosteal sarcoma. Tumors of this type arise from the inner layer of the periosteum and vary in consistency in different tumors.

2. Telangiectatic bone sarcoma, central osteogenic sarcoma, bone aneurysm, and malignant cyst are all terms denoting the same tumor, which arises in the medulla or the marrow canal and develops from the fibroblasts. They present enormous vascularity but there is no great bulk of tumor tissue.

3. Sclerosing osteogenic sarcoma. This tumor may be periosteal or central and it produces much dense solid bone.

Generally speaking there is a great variation of structure in the osteogenic sarcomata, depending upon the differentiation of the fibroblasts.

Benign giant cell sarcomata occur principally in the marrow cavity of

the long bones and cause an absorption of cancellous bone. There is seldom invasion of the soft parts and metastasis never occurs in this type. Failure to differentiate this lesion from malignant central sarcoma has often led to needless amputation.

Myeloma is a specific malignant tumor of the bone marrow.

Endotheliomata require regid elimination of outlying primary foci. As a primary lesion they are very rare.

Diagnosis is the real problem and like other malignancies the cases often come too late to the physician's attention. Invariable pain in a bone calls primarily for an x-ray examination. Too often in malignancies this pain is attributed to "rheumatism," etc.

Coley and Bloodgood both agree that pain is the first conspicuous symptom of bone sarcoma; swelling, pathological fracture and impaired function are later symptoms. There is never muscle spasm and atrophy, as in tuberculosis.

Periosteal sarcoma well developed is recognized by a dense shadow about the shaft of the bone, sharply localized with trabeculae of new bone formation radiating outward from the shaft to the tumor. In central tumors a benign lesion in the marrow cavity may give rise to difficulty in interpretation. In central sarcoma there is an area of marked absorption in the end of the bone, its limits abrupt, the cortex thinned out but not expanded. In the giant cell sarcoma expansion of the cortex is usually marked and there is a characteristic mottling in the area of rarified bone. Generally speaking the prognosis for any form of bone sarcoma is bad. The great variation found in these tumors renders diagnosis extremely difficult and because the verdict may have such far reaching consequences to the patient no amateur should rely upon his own judgment of bone sarcomata.

When amputation is necessary, as it is in most periosteal forms, exarticulation is seldom necessary. The hopelessness of any form of treatment has led to the trial of more conservative methods on the part of some workers. Coley uses mixed toxins, sometimes combined with radium, and he reports some cures from this form of treatment. Radium alone is not effective.

For the central group treatment is about the same and results are not much more satisfactory.

A Peculiar Characteristic Metatarsal Disease. H. J. Panner, M.D., Acta Radiologica, 1:319, April, 1922.

THE roentgen picture of this peculiar disease shows that without doubt the starting point is the capitellum metatarsi. There is more or less flattening of the distal surface of the joint and the structure of the epiphysis shows some changes. Later on, growing condensations and irregular rarefactions occur. "Arthritis-deformans-like alterations may appear in the joint as well as thickenings of the diaphysis." The head of the joint may become more or less deformed but the structure of the bone will finally become normal. Atrophy of the bones of both metatarsals concerned or of any other bones of the affected foot was only once observed throughout the thirteen cases studied. The progress of the disease, as a rule, presents symptoms too slight to receive recognition and thorough treatment is not often necessary. When it is it usually consists in sparing the affected foot in every way. Thyroidin may hasten the cure. Operative treatment is rarely needed, and never needed in the younger patients.

Koehler and others have had experience with such cases but only Koehler has closely considered them and the author believes Koehler has seen them only in the latter stages and has not therefore observed, as has the author, that the origin of this disease always occurs before the growth is complete.

The author and Koehler agree that the disease is not caused by tuberculosis, syphilis, or osteomyelitis, but they differ on the view that arthritis definitely localized here is probable. The author believes that it sometimes is thus localized.

Also he believes that there is a relationship between this disease and Calve-Perthes' hip disease—their whole clinical courses being similar to each other and the roentgen picture showing points of similarity, e.g., origin in the epiphysis with flattening, more or less widened joint fissure, etc.

The Examination of the Teeth in Group Medicine. Boyd S. Gardner, D.D.S., Mayo Clinic, Minnesota Med. 5:356, June, 1922.

THE necessity of roentgenographical examination of the mouth is "not entirely appreciated either by the medical or dental professions. Certain members of both professions still consider it quite ridiculous" to make such an examination providing the patient is wearing a full upper or lower denture. However, this examination is necessary and is due the patient suffering from a systemic condition wherein a focal infection is suspected.

There are many advantages in checking up the clinical and roentgen ray findings at the same time. Full mouth roentgenograms make comparison with the normal possible. Residual roots and granulomas, impacted and unerupted teeth are often unexpectedly revealed in the course of a thorough examination.

Extraction is discussed in its general aspects. Alveolotomy carried out with proper restrictions gives satisfactory results and should not be condemned unqualifiedly. Extraction alone is not sufficient to eliminate oral infection and dentists should make a report of dental findings to the physician whose responsibility has not ended by simply recommending extraction. It is the duty of the dentist to decide whether local conditions require extraction and the duty of the physician to decide whether systemic conditions warrant it, and cooperation between both professions is earnestly to be sought.

Research Institutes and Their Value. Francis Carter Wood, M.D., Science, 55:657, June 23, 1922.

THE following is an abstract of an address delivered by Dr. Wood at the opening of the new laboratory of the Collis P. Huntington Memorial Hospital, Harvard University Medical School. The laboratory is equipped for research in the field of biophysics.

The thinker must work out his great achievements protected from interruption and annoyance and apart from the general current of existence. This is one reason why the garret and sometimes the cellar has witnessed the birth of many a great discovery.

However, the garret plus sealing wax, some wire, a few pieces of broken glass—and brains, no longer suffices. Brains plus equipment of great delicacy and cost are absolutely essential today, as also is organization and classification of research problems, together with a higher degree of collaboration among scientists than has even before existed.

Had this laboratory been earlier at the disposal of the "brilliant group of physicists, under the leadership of Professor Duane, have made so many important advances in the theoretical study of x-rays" it is very likely that the recent practical triumphs in this field which now are credited to continental workers might instead have originated in America.

"The world will profit by the investigations which in the future will be made in this laboratory for * * * the modern scientist gives freely and at once to the public everything he achieves. * * * The true investigator's chief stimulus is love for his science" and, whether or not the cancer foe will be routed by research at Har-

vard or elsewhere, true men of science at Harvard will put forth their entire effort in a noble and brave attack.

The Value of Roentgen Therapy in Dermatology. George M. Mackee, M. D. *and* George C. Andrews, M. D. Am. J. Roentgenol. 9:241, April, 1922.

THIS is a useful paper naming eighty diseases and conditions of the skin amenable to roentgen therapy. These are grouped into thirteen divisions according to susceptibility to roentgen therapy and results obtained with other forms of therapy.

The Roentgen Ray Treatment of Diseases of the Skin. H. H. Hazen, M.D., Am. J. Roentgenol. 9:247, April, 1922.

DR. Hazen gives specific results obtained upon private patients, using MacKee's technique. He states in conclusion that the roentgen ray is the most useful single therapeutic agent possessed by the dermatologist, being of the greatest value in both malignant and benign tumors, keratoses, warts, eczema, acne, lichen planus, some forms of tuberculosis, sycosis and folliculitis of the back of the neck, tinea tonsurans, tinea barbae, some cases of pruritis, granuloma annulare and mycosis fungoides.

X-Ray in Dermatology. C. Augustus Simpson, M.D., Virginia M. Monthly, 49:122, June, 1922.

THE author divides the history of radium therapy into three eras: the optimistic, pessimistic, and the realistic. It is as unfair to judge the roentgen ray therapy of today by that of ten years ago as it would be to judge the surgery of today with pre-aseptic surgery. Ten years have wrought wonders and the future decade promises wonders surpassing the present ones.

The scope of the science has so widened that therapy and picture work he believes should be in charge of different operators using separate and special x-ray machines and tubes.

Roentgen sickness he believes is on the verge of its elimination through the study of blood and tissue chemistry. The biological aspect and importance of x-ray research is discussed.

In the specific discussion the writer states that he considers the roentgen ray to be the greatest single therapeutic asset ever placed in the hands of the dermatologist. Accurate dosage and diagnosis are essential and some telling illustrations of harm wrought when these two factors were at fault are given. The age of hocus-pocus, the writer states, is passed and the time is near at hand when "some physicians must either give up roentgen ray therapy or else devote enough time and energy to the subject to master it" and he adds that the same is true of radium therapists.

Not all skin lesions can be cured by the roentgen ray but many are almost entirely dependent upon it, for example, acne pruritis and certain types of eczema. The cure of a well developed eczema, however, is a matter of graver concern to the roentgenologist than is that of an uncomplicated skin cancer. Simple sycosis, lichin chronic simplex and lichen planus are easily cured as is ringworm. In Paris and London where the former prevalence of ringworm led to the establishment of "ringworm schools" for the isolation of the children so afflicted, roentgen ray treatment has led to the abolishing of these schools where formerly thousands of children were segregated.

Besides the lesions mentioned the following ones are benefited by roentgenotherapy: favus, blastomycosis, actinomycosis, dermatitis seborrhoeica, psoriasis, prurigo, granuloma fungoides, leukemia cutis, Hodgkin's disease, various forms of cutaneous tuberculosis and scrofuloderma, lupus, warts, leukoplakia, Kraurisis vulva sarcoma (Kaposi), and Paget's disease.

In acne sometimes the Kromayer and Alpine lamps are superior to x-ray as curative agents but usually they are used in conjunction with it. It is not claimed that the x-ray is the sole therapeutic agent in many of the less common dermatological lesions but it is claimed that it is of inestimable value if used in conjunction with other therapeutic measures and that it is the dermatologist's greatest single asset.

Modern Treatment of Cancer of the Lip. Henry K. Pancoast, M. D., Surg. Gynec. Obst. 34:589, May, 1922.

THE radiologist in his effort to solve the problem of malignancy needs the aid of the physicist, biologist, pathologist and surgeon. In some measure he has been successful where surgery has not, but there is still much to be done, and also much impossible of doing.

At the present time preventive measures, surgical procedures and non-surgical methods are the agencies by which cancer is treated. Preventive measures have a greater field about the mouth than elsewhere.

The non-surgical agencies for combatting lip and mouth cancer are radium, the x-ray and electrothermic coagulation, and possibly the cautery. The essential purpose of this paper is the presentation of the present status of these agents, and surgery is touched upon only as it is incidental to the discussion.

Theoretically all lip cancers should be readily cured by surgery but they are not for the reasons that patients, as a rule, do not present themselves early enough in the course of the malignancy, and that surgery does not always remove all of the cancer.

From the standpoint of methods of treatment, prognosis and statistics, the the general run of cases is classified in three groups: "Primray lesions without evidence of metastasis; cases presenting small palpable nodes in the submental or submaxillary triangles; and those with advanced primary lesion and large nodes in these areas or in the gland group."

Thorough knowledge of the anatomy of the lymphatics is requisite in any form of treatment. In the first group above, surgery is admitted to give good results but the author does not regard it as a complete method of treatment and he advocates pre-operative treatment as well as postoperative treatment. The author himself treats such a case by electrothermic coagulation of the primary lesion; healing takes place within two weeks to a month after this whereupon radiation of the neck is administered once or twice.

For the second group postoperative radiation is refused unless pre-operative radiation has been given as the malignancy does not respond well otherwise and the radiologist is too often given undeserved censure. The writer's method with this group is exactly the same as for the first group. If the enlarged glands do not subside radium implantation or block dissection is then used and is followed by postoperative treatment. The author does not wish to go on record as advocating a non-surgical method for such a case but he believes that it can be so handled successfully with rigid and proper technique.

In the third group of cases no method can accomplish very much though radiation is preferable.

Superficial Malignancies. Charles F. Bowen, M. D., Am. J. Roentgenol. 9:255, April, 1922.

YEARS of experience have led the author to conclude that roentgen rays, radium and electric coagulation in proper combination will cure any cancer *within reach*.

Dr. Bovee's theory of "sickening" the cancer cells before applying heat led Dr. Bowen to employ a massive dosage of roentgen ray to the growth and surrounding tissue followed by

electric coagulation of the superfluous tissue. As an added measure he applies radium to the open ulcer. All three methods are used at one sitting.

The large majority of patients so treated present healing within one month of treatment though some have to receive a second roentgen ray treatment to accomplish this.

Radiological Ethics. Editorial, Jour. Michigan M. Soc. 21:269, June, 1922.

THE Wayne County Medical Society, Michigan, thus answers the queries of a Detroit roentgenologist regarding the ethics of his profession:

"Marked freedom with broad discretional powers on the part of all x-ray men in imparting information is advised; first, because of the possibility of legal involvements; and second, because of the necessity of maintaining friendly relations with the men who refer their work to them. The Committee feels that courtesy should be mixed with firmness, and discretion and reserve with judicial freedom of action. * * *

"An x-ray man receives compensation, not for the act of making the picture, but largely for the opinion he renders, based on information derived from the pictures. Viewed in this light your opinion might be given to any reputable physician interested in the case, just the same as an opinion is given by the ordinary bedside consultant, having always in view, however, the necessary courtesy to the physician who first referred the case to you."

According to the Corporation Counsel of Detroit, hospitals have the legal right to retain all records, laboratory findings, x-ray plates and prints and they also have "the sole right in all such records, documents, and photographs, whether secured in connection with a private pay patient or a charity patient."

Generally speaking, the guide posts are the patient's interest and the golden rule.

A Conception of Chest X-ray Densities Based on a Study of Granite Dust Inhalation. D. C. Jarvis, M. D. Am. J. Roentgenol. 9:226, April, 1922.

THIS paper presents an interesting study carried out to determine the incidence of tuberculosis among granite cutters. Early in the investigation films were checked off showing densities suggestive of tuberculosis but the subjects appeared to be in excellent health, declared they were well, and were working every day. Physical examination yielded no constitutional or physical signs indicative of tuberculosis and repeated and careful examination did not change these deductions.

"After this observation the only deduction which seemed warranted was that which led to the conclusion that granite dust inhaled charted the highway for all other irritants gaining access to the lungs by aspiration, whether they were mechanical, bacterial or chemical. It was realized that a pathological process was being observed, which was slight in its beginnings, generalized in its distribution and slow in its development."

The author's summary is as follows:

1. "Film densities are like the shifting sand of the sea, and because a density is present at the first examination seems to be no reason for expecting it to be present in a subsequent one.

2. "The evidence tends to show that film densities bring into prominence the lung and pleural lymphatics.

3. "The same densities are brought into view by various causal factors, apparently being no way in which the roentgenologist can determine, without the aid of the clinical history, the exact cause of the densities he is viewing.

4. "When other dusty trades are investigated the necessity for serial roentgenograms in studying a chest condition will be more appreciated.

5. "There seems to be a definite manner in which the densities progress from stage to stage in the development of chest film densities.

6. "It is a question whether the roentgenologist should report on the basis of stages with their pathological import rather than on the basis of the causal factor, which latter it would seem is the clinician's province to determine.

7. "The usual basis for diagnosing tuberculous activity is seen so many times on films of granite cutters as they leave and reenter the trade, that it hardly seems possible to consider the phenomena more than the indication of a lung working under stress.

8. "It would seem that the next step in tuberculosis is the economic one, when by means of wholesale x-ray examinations occupations will be determined which produce a suitable preparation of the soil for the development of a tuberculous process."

An interesting result of this study was the determination of the type of individual not apt to be injured by this work. After detailed study it was decided that an individual was a good risk in this industry in proportion to the absence of lymphoid tissue in the upper respiratory tract.

"One who works from an economic side is obliged to admit to himself that an early case from a medical point of view is a far-advanced case from the economic standpoint, for many times it means the end of an industrial life. * * * Twice a year at least a worker in a dusty trade should have a roentgen examination of his chest in order that it may be determined whether he has reached the suitable soil, suitably prepared, stage."

Apical Pleuritis: A Statistical Study of Stereoscopic Roentgenograms. Jas. G. Van Zwaluwenberg *and* A. D. Wickett, Am. Rev. Tuberculosis, 6:106, April, 1922.

THIS is a study based upon stereoscopic roentgenograms of two hundred and sixty-seven, presumably normal, students' chests. These students were in the early twenties and were mostly Americans, coming from better than the average home, and at the end of their third or fourth year of residence at the University of Michigan.

The authors had frequently in their previous experience noted the occurrence of a roentgenological sign over the extreme apex of the lung, which was interpreted as an evidence of a pleural thickening. "Evidence has been adduced of its close association with tuberculosis of the parenchyma of the lung." It is believed to be the result of a tuberculous infection of the pleura in various stages of progression and retrogression. Some point about the mouth or pharnyx, specifically the tonsil, is the port of entry of the infecting organism which reaches the lung by way of the pleura."

In the study two hundred and fifty-eight stereoscopic pairs were secured. Ninety-six showed the pleural line over one apex or both. There were sixteen observed cases of pulmonary shadows. Ten of these had both lesions present, which leads to the conclusion that one lesion predisposes to the other. The authors' conclusion is that these pleural shadows are a record of a past unsuccessful attempt at the invasion of the lung by the pleural route.

As a diagnostic and prognostic sign this shadow is valuable only as one learns to distinguish between the progressing and the arrested lesions.

The pleural line may be an indication of a progressive and serious invasion of the lung, but the fact that it was present in 37.2 per cent of apparently normal individuals makes it absurd to attach more than minimum importance to this shadow, and its significance must be judged in the light of other findings.

Careful employment of the x-ray is of great aid in the study of the etiology and pathological sequence of this disease but it is for the internist to decide whether a patient is simply tuberculous or has tuberculosis.

The Value of the X-ray in the Diagnosis of Tuberculosis. Charles Edward Hamilton, M.D., Long Island M. J. 16:202, May, 1922.

THE value of the x-ray in pulmonary tuberculosis consists in revealing an abnormal condition in the lungs, though it is impossible usually to properly interpret these findings without recourse to other clinical methods. Its chief use is confirmatory and in showing the exact extent, location, and character of the lesion. It has a definite value also in ruling out or proving tuberculosis in cases with doubtful physical signs though there are cases found without definite physical signs and with negative x-ray findings yet positive sputum. There may also be cases with physical signs which give a negative plate. Therefor clinical data must for the present remain more or less the deciding factor in tuberculosis.

Primary Carcinoma of the Lung. Robert I. Rizer, M. D., *and* Harold C. Habein, M. D., Minnesota Med. 5:352, 1922.

X-RAY diagnosis of carcinoma of the lung is thus disposed of in this article: "The x-ray in our experience has not been of material aid in the diagnosis of primary carcinoma of the lungs. There is no characteristic appearance as seen in the x-ray plate. The most frequent finding is a gross peribronchial thickening with nodulations seen usually in the lower or middle lobes. If seen early the condition is most likely to be interpreted as an unresolved pneumonia, bronchiectasis, or chronic pulmonary abscess. Later plates, however, showing the rapid extension of the mass, with or without involvement of the pleura, will either give the diagnosis or confirm the previous clinical diagnosis of carcinoma. The greatest aid which the x-ray can give is in ruling against metastatic tumor or tuberculosis. Both conditions are easily differentiated by x-ray from primary carcinoma, except where the pleura is involved."

The X-ray Examination. H. M. Tovell, M. B., Canad. M. A. Jour. 12:408, June, 1922.

THE x-ray diagnosis of pulmonary tuberculosis depends upon the definite changes wrought by the invasion of lung substance by tubercle bacilli. The reaction from this causes a round cell invasion at the site of the lesion which in turn is followed, in favorable cases, by the formation of fibrous tissue and calcification; in unfavorable cases it is followed by consolidation, cavitation, etc.

The x-ray will show slight flocculent shadows from cellular changes, dense shadows from consolidation, and increased translucency where lung substance has been destroyed. The changes wrought by round cell invasion and those wrought by early fibrosis are very difficult to distinguish and render it impossible to distinguish between activity and healing. Later fibrosis is not difficult to distinguish.

Three radiographic types of pulmonary tuberculosis can at present be distinguished, namely, hilum tuberculosis, peribronchial infiltration, and parenchymatous infiltration. In the first of these types the changes are principally around the hilum and show an increased shadow, more or less woolly. In the second type fanshaped peribronchial markings extend from the peripheral portion to the hilum and are studded by whitish nodules. Hila shadow changes are present. In parychmyatous infiltration small whitish, more or less discrete, shadows are characteristic and are found in small or wide areas in the upper chest in the region of the bronchioles. Pre-bronchial markings connect these shadows with the hilum.

Evidence may be present of all three types with one predominant. Knowledge of the pathology of the disease is absolutely requisite for reliable diagnosis, which, with this knowledge and with experience, may be fairly certain.

With respect to cavities these will be more or less annular with lung destruction surrounded by a zone of infiltration which shows a shadow inclosing a space in which lung markings are absent thereby distinguishing it from localized pneumothoraces in which these markings are at first apparent but disappear after a period of time.

Fibrosis may result from the tubercle bacillus or from other microorganisms and the differentiation is difficult, making history and physical findings essential to diagnosis. Pneumoconiosis and gas inhalation produce conditions resembling that produced by the tubercle bacillus.

An x-ray examination should be performed by stereoscopic plates and the screen, but the latter should never be used alone, nor should single plates ever be used.

Only those whose knowledge of the pathology of tuberculosis is coupled with experience in roentgenological diagnosis are competent to pass judgment upon these findings. It must also be borne in mind that the roentgenological diagnosis complements and does not supplant other means of diagnosis and there can therefore be no discussion of relative values.

Empyema. Philip P. Thompson, M. D., J. Maine M. A. 12:275, May, 1922.

IN a discussion of the etiology, pathogenesis and history of empyema of the chest the following discussion upon the importance of an x-ray examination occurs:

"Now knowing our physiology, and before having aspirated to corroborate our diagnosis and determine our bacteriology, it is most advisable, if possible, to take an x-ray. An x-ray examination is of great value and should be done before exploratory aspiration, if feasible, because in aspirating occasionally air is admitted into the chest and confuses the picture.

"Some may ask, 'Why is a roentgen examination of assistance?' Experience has shown:

"1. At times, when physical signs suggest fluid, and even the needle shows pus, the x-ray may show only a pneumonia or a pneumonia and a lung abscess.

"2. It may show several encapsulated collections of pus which require special treatment.

"3. It may show the presence of air as well as fluid, in which case bronchial fistula must be present, which would influence our treatment to be of more guarded prognosis.

"The x-ray should be taken with the patient in the upright position.

"In following the case after operation, the x-ray is of especial value in definitely following the expansion of the lung or the factors causing delay."

Treatment of Diphtheria Carriers by Means of the Roentgen Ray. Preston M. Hickey, M. D., Am. J. Roentgenol. 9:319, May, 1922.

THE writer states that "bacteriological examinations show that the percentage of cures in a selected number of throat cases is greater by the roentgen-ray treatment than by the local antiseptic treatment. The roentgen-ray treatment of diphtheria carriers is more easily carried out than a local treatment of the throat requiring swabbing of the pharnyx, and is very much less dreaded than the operative procedure of tonsillectomy."

Since the above paper was written unofficial reports have been received which claim that the use of the roentgen rays have resulted in the disappearance of the bacilli from the pharnyx within a few days after treatment. An official report will be made with regard to these cases as soon as the data can be collected.

Present Status and Surgical Treatment of Mouth Pathology. Bertram B.

Machat, D.D.S. Long Island M. J. 16:207, May, 1922.

ROENTGENOGRAPHY is one of the topics which the writer includes in his treatment of this theme and he greatly deplores the patronage extended by dentists and physicians to the commercial purveyors of x-ray pictures, since even with the best pictures and the most expert diagnosis only forty per cent of existing mouth pathology may be revealed. This loose and disconnected procedure "leads to failure and stigmatizes a practice, which when consistently and exhaustively carried out, is commonly attended by brilliant results."

The Close Relationship of the Erythrogenetic and Leukogenetic Functions of the Bone Marrow in Disease. Report of a Case of Erythremia. The Roentgen-Ray Treatment of Erythremia. Eugene P. Pendergrass, M. D., *and* Henry K. Pancoast, M. D., Am. J. M. Sc. 163: 797, June, 1922.

BLOOD pictures of a few cases reported in the literature show manifestations of both erythremia and myelogenous leukemia. These cases have polycythemia, cyanosis and enlarged spleen, and in addition have a definite percentage of myelocytes in the blood.

If there is such a thing as a combination of erythemia and myelogenous leukemia, or a midgroup between these, then the authors believe that the case here reported would come under such a heading, although the disease was primarily erythremia and later under some unknown stimulus the abnormal number of myelocytes appeared. Roentgen ray treatment was instituted and after various fluctuations the blood again became normal following the seventh series of treatments. The patient feels very well though the size of the spleen is larger than at first, and this in spite of occasional cross-fire radiation treatments. The writers report in a foot note, however, that a recent blood count showed the patient to have an anemia in which the red cells number 3,000,000 and the white count is normal, hemoglobin sixty-five per cent.

In leukemia the authors advise inhibitive doses over the long bones to inhibit the formation of red cells and destructive doses over the spleen. In erythremia they advise inhibitive doses over long bones and stimulating doses over the spleen, though as yet the basis of this phase of treatment is theoretical. A complete blood count should be made once a week.

Experimental data show that the spleen is more sensitive to roentgen rays than is bone marrow and that after moderate doses the leukocytes show an initial rise followed by a pronounced fall with subsequent rise to normal. The red cells show an initial fall which may last for a long period or rise to normal within a few days. The following conclusions have been reached, though final judgment as to the success of radiation treatment is withheld for the present.

CONCLUSIONS

1. "Erythremia is a disease of the erythroblastic tissues of the bone marrow.

2. "Roentgen rays destroy or inhibit the formation of red cells.

3. "Roentgen rays should be used in the treatment of erythremia.

4. "Roentgen rays should be used in the treatment of secondary polycythemia when such cases fail to respond to other treatment such as drugs, venesection, etc.

5. "Roentgen ray treatment has been efficacious in the case reported above, and it has proved of value in such cases reported by other roentgenologists.

6. "Roentgen therapy affects a more permanent result than any other therapeutic measure used or recommended up to the present time."

Barium Meal Study in Gall-Bladder Diagnosis. Lincoln Kallen, M. D., Northwest Med. 21:172, June, 1922.

THE writer believes that instead of emphasizing the importance of searching for stones in gall-bladder disease that a careful analysis of the indirect evidence of gall-bladder disease readily and consistently demonstrated by barium meal study should receive greater attention. His summary is quoted in the following paragraphs:

"Twenty-one signs of chronic cholecystitis encountered in barium meal study are reviewed. This is probably not a complete list but comprises the most accurate signs met with in present day methods.

"The secondary manifestations of chronic gall-bladder disease are noted and their tendency to be responsible for sympatomatology emphasized. The desirability of thorough search for primary focal infection is noted.

"The argument is presented to justify the more routine use of barium meal study, and a just appreciation by the clinician of the roentgenologist's position in gall-bladder diagnosis is sought."

Fluoroscopy in Diseases of the Abdominal Organs. Arthur Lawrence Holland, M. D., New York M. J. 115:659, June 7, 1922.

ALL physicians may not agree as to the relative value of x-ray plates, and their opinions vary probably according to their experience with good or bad plates and indifferent reports. This paper deals with the subject from the viewpoint of the internist.

Both plates and fluoroscopy have limitations and the ideal method includes the use of both. Protection must be kept in mind and "exposure to a ray the elements of which are a five inch gap to five mil., should not exceed twenty minutes within a period of two weeks as the effect is cumulative." The operator should wear lead impregnated gloves of the heaviest kind, as more than fifty per cent of the worth while evidence must be brought out by manipulation. Ten minutes should be allowed in the dark room for eye adjustment before examination is attempted.

The patient should not eat breakfast the morning of the examination nor should any cathartic be taken. At least one-half pound of barium is necessary for the meal. The patient, stripped below the waist, stands first in the anteroposterior position for examination of the heart, arch and lungs, then in the right anterior three-fourths oblique position and drinks the barium rapidly. Any defect or dilatation in the esophagus calls for a plate to be taken as an aid in differentiation of malignancy. The stomach must be examined from all angles and by deepest manipulation. The manipulation requisite for duodenal pathology is most difficult but proper technique is a question of patience in practice; nearly all such pathology can be diagnosed by the fluoroscope without plates. Only a little experience is needed to "type" a colon. If the appendix retains a fixed position or "kinks up" it is usually the seat of pathology but failure to visualize the appendix means nothing alarming.

The question of spasm is discussed. Other sources of trouble in the abdomen may be expressed "in this manner, so it is extremely dangerous dogmatically to ascribe this or that fluoroscopic syndrome to any particular lesion anywhere within or outside of the abdomen."

One hundred consecutive cases (postpyloric and duodenal ulcer, gastric ulcer, carcinoma, extra-gastric lesions) from the records of the writer's two surgical services at the New York Hospital when checked up gave ninety per cent correct diagnoses.

X-ray Evidence of Abdominal Small Intestinal States Embodying an Hypothesis of the Transmission of

Gastro-Intestinal Tension. R. Walter Mills, M. D., Am. J. Roentgenol. 9:199, April, 1922.

WITH the exception of lesions of the duodenum the writer states that there has been no great effort at roentgenological investigation of small intestinal conditions, either normal or abnormal. The outlines which suggest gross obstruction are recognized but with the exception of gastro-jejunal ulcer there has been no conception that direct evidence of the involvement of the small intestine might be obtained.

For ten years past Dr. Mills has kept on file data secured in each x-ray examination made by him, systematically recording all findings not understood, and through this practice it became evident to him that certain small intestinal forms were associated with certain conditions that led to the idea of recoil with relative stasis, which he found to be supported by collateral evidence on every hand. Since 1916 atypical small intestinal outlines have been observed approximately six hundred times in making examinations of six thousand different patients. These findings grew more frequent as they were better appreciated. The accidental factor of the patients standing while a series of cases were plated made these findings apparent in the first place.

The subject is difficult to present in abstract form — because complicated and resting upon unrecognized principles. Each point is represented by an illustration or two and the exposition made with the aid of these. Appreciation of the evidence in the films is a matter of experience and education as one must become sensitized to changes in outline that at first are not apparent.

The following principles are stated and discussed and the evidence in support of them is submitted by the aid of sixty-two plates:

1. "When there is an organic alimentary obstruction there will be dilatation and motor delay proximal to it, their degree determined by that of the obstruction and the resulting proximal dilatation or hypertrophy.

2. "Evidence strongly suggests that the same far reaching proximal recoil occurs in somewhat less degree in functional stasis of the colon as in marked colonic constipation. The x-ray apparently shows that not only is there resulting motor delay throughout the entire colon but also secondarily in lesser degree in the small intestine.

3. "Any alimentary sphincter that is subjected to increased intravisceral tension originating either immediately proximal or distal to it tends to give way, and if this tension is sufficiently great the sphincter becomes divulsed and incompetent, dilates in common with the contiguous dilated gut with resulting disturbance of proximal and distal motility.

4. "Any acquired lack of resilience in the gut wall, as from inflammatory or other pathological condition, will lead to recoil and relative proximal stasis.

5. "Rarely, but not to be mentioned as a possible principle, lesions lessening the recoil absorbing power of at least certain proximal portions of the alimentary tract determine a greater motility distant to it.

6. "It has been assumed that tension within the alimentary tube if not a constant throughout, still may be proximally influenced by changes in distal tension.

7. "Whenever there is over-rapid small intestinal motility from any source, the small intestinal forms will reflect this indicating over-distension and increased fluidity of the intestinal contents, more noticeable in the jejunum."

In the discussion following this paper high tribute was paid to Dr. Mills. Dr. Van Zwaluwenburg in the course of his discussion had said that after six years of study upon the subject he believed the greatest field in the future was in the small intestine and that roentgenologists are not pursuing this phase of their work as its importance warrants.

Clinical Lecture: Carcinoma of the Rectum, A. T. Bazin, M. D., Canad. M. A. J., May, 1922, p. 281.

1. "Carcinoma of the rectum is not uncommon in individuals of a comparatively early age.

2. "Abdominal cases must not be permitted to pass unexplained.

3. "Rectal bleeding and painful defecation demand such examination as will satisfactorily explain the cause.

4. "In carcinoma of the rectum the scirrus type has a more unfavorable prognosis than the soft adenomatous type."

The Importance of Roentgen Ray Localization of the Intestinal Tube. Jacob Buckstein, M. D., New York M. J. 115:690, June 7, 1922.

1. "Various methods recommended for determining the location of the intestinal tube beyond the stomach are, with the exception of the x-ray, at best, highly suggestive and may be misleading.

2. "Even the aspiration of the duodenal fluid, while acceptable as a rule, may occasionally prove unreliable.

3. "The x-ray is essential for accurate determination of the exact area from which intestinal fluid for study has been obtained, and also for the exact point of entry of medication and of food.

4. "The x-ray will often help to determine the cause of obstruction in the curve of the tube."

A Practical Method of Roentgen Examination of the Heart Based Upon a Study of One Hundred Consecutive Normal and Abnormal Cases. Rolla G. Karshner, M. D., *and* Robert Helm Kennicott, M. D., Am. J. Roentgenol. 9:305, May, 1922.

ONE hundred two hearts were examined radiographically by all the accepted methods with the following conclusions: (a) The roentgenoscopic examination of the heart is far superior to the use of the seven foot plate. (b) A thorough roentgen-ray study of the heart embraces consideration of four elements; the shape of the cardiac shadow, its size, its motion, and the aorta. (c) The heart form is best studied by the roentgenoscope, the patient being examined in the direct and the oblique positions. Changes in shape in pathological hearts are due to relative enlargement of certain chambers of the heart as compared with other chambers, and such localized enlargement is best estimated by the A-V ratio of Van Zwaluwenburg and the use of the oblique positions of Vaquez and Bordet. The roentgenoscopic examination of valvular disease adds a quantitative estimation to the qualitative findings of the stethoscope. (d) The so-called cardio-thoracic ratio is a grossly inaccurate index to the actual size of the heart. (e) There are two practicable methods of accurately estimating the cardiac size from the orthodiagram: First, the use of the planimeter; second, the simpler method of Van Zwaluwenburg, which consists of the product of the long and short diameters of the silhouette compared with the normal, based upon body weight. (f) Expression of the cardiac area as a percentage of the normal is more satisfactory to the clinician than the statement of the actual area. (g) Much information may be gained from the study of the cardiac motion by the experienced observer. One notes the force, the tone, the organization, the co-ordination, the presence of excessive or insufficient motion, the intrinsic motion of various chambers, and the transmitted motion of the heart as a whole, together with its relationship to other structures in the chest. (h) The aorta, which is normally an inconspic-

upon portion of the cardiac shadow, takes on definite characteristics in certain cardiac pathology. Chiefly among these are the changes due to age, hypertension, arteriosclerosis, lues, and pathology in the aortic valve."

Roentgen Rays and Radium in the Diagnosis and Treatment of Carcinoma of the Prostate. H. C. Bumpus, M. D., Am. J. Roentgenol. 9: 269, May, 1922.

SUMMARY

1. "The average duration of cancer of the prostate, if untreated, is approximately three years.

2. "Roentgenograms show that metastasis to the bone occurs in about one-third of the cases of cancer of the prostate.

3. "Metastasis from atypical carcinoma of the prostate, in which the cells, because of their tendency to early metastasis, produce only slight local enlargement, may be frequently mistaken for Paget's disease.

4. "The clinical study of these cases demonstrates that in order to treat successfully cancer of the prostate with radium it is necessary to use in the aggregate large doses (3,000 to 4,000 mg. hours), exposing all parts of the gland to comparatively small doses.

5. "It is demonstrated that the increased duration of life following radium treatment in cases of cancer of the prostate is in direct proportion to the amount of radium radiation applied.

6. "No one method of application radiates all portions of the gland.

7. "The malignant gland must be radiated by urethral and rectal exposures, and by needles inserted directly into the neoplasm in order to produce complete radiation of all portions.

8. "It is demonstrated microscopically, that large doses of radium placed directly into the gland affect only a limited area; this is substantiated by the clinical findings which prove that the course of the disease after such treatments is but slightly affected.

9. "In the parts of the gland affected by the radium, fibrous tissue is produced which enmeshes and compresses the cancer cells, preventing their further proliferation. If this process could be brought about in the entire growth, complete cessation of the disease would result.

10. "Sacral anesthesia is a useful adjunct in the application of radium needles, making it possible to place the radium accurately and to change the position of the needles without pain; thus a more thorough radiation of the gland is accomplished."

Pneumoperitoneum in Kidney Diagnosis With Special Reference to the Detection of Retroperitoneal Masses. L. R. Sante, M. D. J. Urology, 7:451, June, 1922.

PNEUMOPERITONEUM is not only useful from the standpoint of diagnosis, but often gives the surgeon information as to conditions which will be encountered upon operation.

Occasionally the method is useful in detecting the presence or the absence of a kidney, or in detecting abnormal mobility.

Enlargement of the kidney requires careful analysis of the shadows as this condition may be due to one of various causes, perhaps to fat, carcinomatous metastasis, or to the kidney itself.

For the examination of the outline of the kidney the lateral position is used but if an abdominal mass is found present the retroperitoneal position is necessary to determine origin and relationship to thickening.

The radiographic characteristics of various retroperitoneal masses are described, for example new growths, perinephritic abscesses, tumor masses, psoas abscesses and carcinoma; these are also described for pyelitis, pyelonephritis and tuberculosis of the kidney.

Pneumoperitoneum is of advantage also in demonstrating certain lesions of the urinary tract, and when properly used the author considers it is no more dangerous than ureteral catheterization with injection of opaque material.

The method is not a short cut to diagnosis of all intra-abdominal lesions and should be used only with rational consideration after all other routine methods have failed and it must be interpreted in conjunction with other clinical findings.

Pneumoperitoneum as an Aid in the Diagnosis of Cardiospasm. Samuel Iglauer, M. D., New York M. J. 115:745, June 21, 1922.

THIS paper reports the successful use of pneumoperitoneum in a case of obscure cardiospasm and the writer believes that the method should prove of considerable value in other obscure cases, and states that it is practically free from danger.

Tumors of the Urinary Bladder. Milton Weinberg, M. D., J. S. Carolina M. A. 18:137, May, 1922.

THE high frequency current used through the catheterization cystoscope for the treatment of bladder tumors is ideal for all benign and many malignant papillomata but not successful in malignant papillomata and never for papillary carcinoma or any other type of tumor that has invaded the bladder wall. Failure to yield to this treatment is conclusive evidence of malignancy.

The status of radium in the treatment of bladder tumors is not fully established. Geraghty has found it useful in some cases. Judd thinks its chief value is in inoperable cases.

Modern Methods of Urological Diagnosis. N. P. Rathbun, M. D., Long Island M. J. 16:173, May, 1922.

THE writer in his practice aims at diagnosis in one sitting. This grouping of the several examinations is a feature of urological diagnosis for which he claims originality.

In addition to the history and physical laboratory examinations he insists upon a pyelogram. This may not prove necessary always but it does no harm and often great good, for if made a routine procedure it often elucidates important data which otherwise would escape notice.

Importance of Roentgen Examination in the Early Diagnosis of Renal Calculus. William H. Schmidt, M. D., New York M. J. 115:533, May 3, 1922.

THAT a renal calculus should reach a large size with accompanying infection, and should be allowed to almost completely destroy the kidney before radiographic study has been even attempted, is almost inexcusable. Indefinite abdominal symptoms extended over a long period of time call for radiographic study together with careful consideration of the history of the case. The majority of these cases, if symptoms are due to renal calculi, can be diagnosed by aid of the x-ray and the kidney saved as a result. The responsibility of recommending the examination rests largely with the general practitioner.

X-rays in Obstetric Practice. Edward W. H. Shenton, M. R. C. S., Lancet 202:860, April, 1922.

THE writer states that useful information might be obtained from subtle evidence many times were it not for the fact that "surgeons of the present day ask for radiographic results which in their clarity would almost satisfy a common jury."

He goes on to relate that two conditions hamper radiographic findings in obstetric cases, namely, the quantity of fluid and the paucity of mineral matter in fetal bones. Perhaps by the fourth month, and certainly by the fifth or sixth, the rays may often be useful

in determining the presence of pregnancy or abdominal tumor, position, relations of head and pelvic canal, and the presence of twins.

He cites one case from his own practice where use of the x-ray obviated a contemplated induced premature labor because there was shown to be room and to spare in what was at first thought too small a pelvis.

These pictures will not often be clear but they will be sufficiently so to give the needed guidance and the x-ray exerts no harm at all upon the fetus.

As to technique he says: "I would suggest anteroposterior position for head and pelvis, the latter being tilted so as to give a comprehensive view of the pelvic canal. Stereoscopy is useful if practicable. For the abdomen the lateral position, the patient lying on her side (is the proper one). The plate must be large and comes well over the crest of the ilium. Intensifying screens and other aids to rapidity in the photographic process will be essential."

Radium Treatemnt of Myoma of the Uterus and Myopathic Bleeding. C. Jeff Miller, M. D., Surg. Gynec. Obst. 34:593, May, 1922.

ANY other than the present very satisfactory surgical method of treating myoma of the uterus "must present properties rarely possessed by a therapeutic agent, and the result obtained by such a remedial agent must show that the relief is permanent and that its use is safer than operation and gives a larger percentage of preservation of physiological function than an operation performed by a skillful surgeon."

The writer believes that radium is such an agent and for proof cites results secured in one hundred and eighty-three cases treated with radium and now observed over a period of more than seven years. As proof that he is not radical upon the subject of roentgen therapy he cites the fact that he has employed surgery in nearly an equal number of such cases during the same period, according as the factors of age, type, social situation, size of tumor, condition of the appendage, evidence of previous infection, and general condition of the patient demanded this form of treatment.

A review of these cases treated by radium "warrants the conclusion that a large percentage of the cases of myoma of the uterus, formerly subjected to radiation can be permanently and safely relieved by radium and that practically all cases of uncomplicated essential hemorrhage can be cured by radium."

The Treatment of Myoma Uteri and Menorrhagia with Radium and Roentgen Rays. S. A. Hyderdahl, M. D., Acta Radiologica 4:366, April, 1922.

DR. Hyderdahl in his summary of this paper reports that "of thirty patients suffering from myoma uteri twenty-five were exclusively treated with roentgen rays, and five were given combined roentgen and radium treatment.

"In twenty-five cases a good result was obtained; cessation of the menses, together with complete or partial disappearance of myoma in most cases. Five patients were operated after the roentgen treatment. Of thirteen patients suffering from menorrhagia twelve cases attained to a complete cessation of the menses. In one case there was a recurrence and later on an operation."

Continuous Uterine Hemorrhage of Three Years Duration in a Girl of Seventeen Years, Cured by One Application of Radium. D. Y. Keith, M. D., Kentucky M. J. 20: 365, May, 1922.

THIS patient before receiving radium treatment had been subjected to curettage and to a ventral suspension to relieve a condition in which menstruation had been present continuously for more than a year. Improvement was only temporary. Internal glandular secretions administered produced some improvement for a time but this likewise did not prove to be permanent. Upon her admission to the hospital for radium treatment menstruation had again been daily continuous for more than fifteen months.

Under gas-oxygen anesthesia four needles containing fifty milligrams of radium, one millimeter brass screening, was introduced into the uterine cavity and allowed to remain for one hour and forty minutes. No curettage was performed . The menstrual flow ceased for two weeks whereupon normal menstrual flow made its appearance and since that time (April, 1921), menstrual periods have remained normal and the patient is in excellent general health.

The writer is not conclusive in his statement but gives a very decided impression of believing that this form of therapy, properly administered, may be used without fear of resultant sterility.

The Practical Status of Deep Therapy with the Advent of X-ray Intensities. Edwin C. Ernst, M. D., Southern M. J. 15:448, June, 1922.

RADICAL changes in the technique of radiation such as have lately been made should be accompanied by equally radical changes in the physical and electrical methods of producing such radiation. The method of transforming electrical into radiation energy is and will continue to be a basic problem.

The writer describes the unscientific attempts made and the widely differing radiation reached by some roentgenologists in trying to duplicate the same technique and he exposes and makes plain the fallacies which underlay their reasoning. Much harm has been done by just such inaccurate procedures.

Comparative quantitative and qualitative measurements of the skin and depth doses are essential to proper treatment. The supposed effect of radiation upon normal and pathological tissues must be clearly understood. The radiation dose with reference to the amount the patient has received and his reaction, as well as the amount absorbed by the local tissues must be carefully considered and this depends upon: (1) the intensity of the radiation, (2) its quality, (3) the duration of the exposure, (4) the area exposed, and (5) the kind of tissues receiving such radiation.

The following are the physical factors in every treatment, given from the standpoint of the unfiltered x-ray dose: (1) The voltage applied to the tube and the means used for exciting such a tube. (2) The type of the tube. (3) The current through such a tube. (4) The focal skin distance. (5) Duration of the exposure. (6) Size of area exposed.

The problems of increased focal distance, copper in place of aluminum, size of areas, and reaction of the patient are considered at length.

As to foreign technique he states that it is extremely difficult accurately to compare voltage equivalents between transformers abroad and those employed in America, but there is profit to be derived from the German studies of the ionization method of measurements, relationship of the superficial skin dose to the necessary depth dose, the individual values of various sized filters, most practical focal skin distances with given filters, etc., etc. If any of these physical factors are to be modified the work must be checked on a physical basis, else underraying and overraying may result.

In reply to the question as to whether the present more intensive deep therapy is producing better results he replies that it is. He states that in his belief earnest co-operation of physicist, biologist and radiologist may usher in an era productive of permanent results in malignancy.

He closes with the reiteration of what has been previously stressed, namely, that the radiologist's future rests upon the added precision with which effective electrical instruments and physical methods are selected—and upon the knowledge, training, and skill of the man using them.

THE Modern Hospital, 18:311, April, 1922, contains a short article upon the administration of radium in which Dr. Bowing of the Mayo Clinic is quoted as saying that much of the misunderstanding with regard to radiotherapy is due to negligence as well as to inexperience and incompetence upon the part of those responsible for treatment. He states that it would be almost as absurd to expect good results from surgery simply because of a fine equipment as it is to expect the same sort of results from radiotherapy simply because the equipment is of the best.

In hospitals some one physician should have absolute charge of radiotherapeutics and he should frequently visit other large radium clinics. Consultation with the other members of the staff before therapy is decided upon should be the rule.

Critique of Modern Roentgen Therapy in Cancer. M. I. Sittenfield, M.D., Med. Rec. 101:660, April 22, 1922.

THE writer is enthusiastic in his support of pre-operative radiation in carcinoma, especially that of the breast. This treatment he believes should precede operation by about two weeks, after which postoperative treatment should be given.

The importance of filtration, proper distance, portal of entry and other points of technique are emphasized.

The entire dose with maximum intensity should be given at one time whenever this is at all possible; this is much more preferable than several smaller doses at intervals.

There is need of greater co-operation between surgeon and roentgenologist.

The danger and the prejudice arising from unskillful use of the x-ray is vigorously commented upon.

Modern radiotherapy, the writer believes, is only beginning.

European Impressions and Personal Experience in the Use of High Voltage X-rays in Deep Seated Malignancy. Robert H. Millwee, M. D., Southern M. J. 15:444, June, 1922.

MILLWEE'S technique for malignancy of the pelvis is: Voltage 230,000 peak volts measured with sphere gap. *Filter* ½ mm. Cu. and 1 mm. Al., 10 mm. sole leather. *Skin-target* distance, 24 inches. *Ma.* 4. The ionization method is used for measuring dosage. Four fields, none smaller than five inches, are used and two hours of eight ma. hours gives a good erythema as a rule. Eighteen hundred mg. hours of radium are used treating the cervix and uterus. For heavy patients a thirty-inch skin target is used and for breast cancer forty-inch skin target but only one large field. These principles apply to all cases of malignancy situated below the surface of the skin.

One hundred and eighteen inoperable cases have been treated by this technique and ninety per cent of them show marked improvement; so far no deaths have occurred.

The author regards as reasonable the theory that malignant cells develop a tolerance for roentgen and radium rays and he believes, therefore, that a massive dose at one sitting should be given to all patients in good physical condition. Such patients should have a blood count of over 4,000,000 reds and hemoglobin seventy per cent. Two and one-half million reds and half the whites may disappear as a result of the treatment but the blood returns to normal in from one to two days.

Toxemia has not been so marked as has been observed in German clinics and he believes this is due to the elimination of all gases, noise, and nerve racking elements from the treatment room. In pelvic cases, bladder irritation and diarrhea is sometimes consequert upon treatment.

The writer does not recommend his technique as perfect, in fact he is inclined to work out some further changes in in but he feels much encouraged by the results secured.

The following is his summary of observations made by him in German clinics:

(1) "Voltage of 220,000 peak volts was used. Radium was usually used in connection with x-rays. (2) All believed that the action of the rays on cancer cells was a direct one. (3) That the advantage gained by the employment of x-rays of high voltage (220,000) is that of better dosage to deep seated lesions without permanent damage to essential normal structures. (4) They were unanimous in their approval of the accurate measurement of dosage by the ionization process, and all workers used the method in some form. (5) Heavy filters of from ½ to 1 mm. of copper or its equivalent were used in all clinics. (6) The determination of proper dosage for various types of tissue was considered seriously by all, and the various workers differed but little on this point.

"It was generally admitted that in some cases the proper dose of ray for the destruction of carcinoma cells does not depend upon the histological picture of malignancy as upon the general condition of the patient. The various workers visited were enthusiastic as to results obtained."

The Present Status of Deep Roentgen Therapy in Europe. W. H. Stewart, M. D., Am. J. Roentgenol, 9:315, May, 1922.

THE team work in German clinics where eminent physicists work hand in hand with clinicians greatly impressed the writer upon his visit abroad. He believes that this co-operation accounts in large measure for the great advancement made there of late.

Great differences of technique were noted, but the administration of a death-dealing cancer dose was the same in all large hospitals visited. All are working on the problems of exact measurement of the x-ray dose, deep introduction into the tissues of the hard, filtered x-rays, and the determination of the correct x-ray dose.

The problem of exact measurement of the depth dose, the Germans generally believe, has been solved by the iontoquantimeter which has now been in use two years. The writer gives interesting descriptions of several means of measuring the depth dose in vogue among German workers. He believes that these instruments may be reliable in the hands of a responsible physicist, but that it is not yet safe to state that one can rely upon them entirely.

He states that it is difficult, during a short visit, to exactly ascertain the clinical results and that as a rule he found conservatism upon the subject of ultimate cure.

AN editorial in the Journal of Electrotherapeutics and Radiology, May, 1922, discusses Holzknecht's changed views in regard to the use of massive dosage. He is quoted as saying that the single maximum dose is wise in treating malignancies, but that the medium or fractional dose is the one to be used at all other times. He is also quoted to say that harm has come as the result of the massive dose method.

The editorial goes on to say that "It is difficult to understand how any physician who is familiar with the effects dare use the terrific doses that are being advocated by German physicians, except in the early stages when the tumor or growth is too small to produce dangerous toxic absorption when broken up."

What Every Doctor Should Know About Cancer. Joseph Colt Bloodgood, M. D., Texas S. J. M., 18:77, June, 1922.

DR. BLOODGOOD in addressing a general session of the State Medical Association of Texas laid the responsibility of educating the community in the knowledge of cancer directly upon the general physician, and indirectly laid the responsibility of educating the general physician upon the specialist by his statement that physicians referring cases to himself no longer delay to take this action in any case that shows signs of incipient cancer.

In this paper he discusses the topic of publicity and the question of whether doctors delay in cases of cancer; the warnings of cancer and the fact that they do not differ from those in cases that are not cancer; examination and its importance; the medical adviser; the message in regard to cancer; prevention; what publicity has accomplished; the added responsibility laid upon the medical profession as a result of this education, and the fact that there is no second treatment for cancer, that is, it must be eliminated at the beginning of treatment.

Under this last topic he says: "The selection of surgery, with knife or cautery, radium or x-ray, one or the other, or their combination is essential, because in the early stage of cancer cures should be accomplished in a large percentage of cases if the proper method is applied at the proper time."

In answer to a possible charge by the layman that cancer propaganda is a commercial enterprise he says that "it is commercial only in the sense of the highest height of commercialism; that its advertisement is true and what is promised will be delivered."

The Medical Side of the Cancer Problem. A. C. Scott, M. D., Texas S. J. M., 18:81, June, 1922.

THE text of this paper, read before the same body as the preceding paper, by Dr. Bloodgood, is: "People should know about cancer before they have it. "The enormity of the task of educating over 100,000,000 people can scarcely be conceived, especially as pertains to a subject about which most of them have notions only a few steps removed from heathenism." If every one of the 85,000 members of the A. M. A. did his part there would be eleven hundred people to each physician, but the lamentable fact is that the general physician, as a rule, knows little about the predisposing causes of cancer or its early diagnosis and has only an occasional or a very casual interest in the matter. This inexcusable state of affairs is severely censored and the truth of the writer's charges is supported by his discussion.

Endothermy. George A. Wyeth, M. D., New York M. J., 115:437, April 19, 1922.

CANCER specialists recognize the fact that no one method can be unreservedly adopted, and the value of radium, x-ray and endothermy is appreciated by the up-to-date surgeon.

The advantages of this last form of treatment the writer considers are the following: (1) decreased danger of metastasis and likelihood of recurrence, (2) alleviation of pain, (3) practically no hemorrhage, (4) practically no surgical shock, (5) accurate dosage, (6) incidental sterilization of the wound, (7) satisfactory postoperative condition leads to quick recovery, (8) good cosmetic result.

Some striking results are recounted in cases of facial malignancy, a number of which are described and illustrated.

The Cancer Problem. Herbert A. Bruce, M. D., F. R. C. S., Canad. M. A. J., April, 1922, p. 225.

THE writer believes in excision followed by x-ray or radium.

There is little excuse for fatal termination of cancer originating at the surface of the body.

In judging the effects of therapeutic methods in malignancy the size of the tumor is the sole criterion; relief of pain, circulatory changes in the tumor, and restoration of secondarily impaired function is of little value, even the size of the tumor may be misleading.

The writer sees no advantage from pre-operative x-ray treatment, but advocates postoperative treatment. He disputes the value of radiotherapy for superficial cancer, advocating operation for this whenever possible.

In deep cancer he advocates the x-ray for palliation and as a postoperative measure. "Radium seems to have a special place in carcinoma of the cervix uteri."

Observations on the Use of the Copper Filter in the Roentgen Treatment of Deep Seated Malignancies. Thos. A. Groover, M. D., Arthur C. Christie, M. D., Edwin A. Merritt, M. D., Southern M. J., 15:440, June, 1922.

THE necessity of being able to deliver as effective a "knock-out" blow to deep seated lesions as is now possible to deliver to superficial ones is apparent from the fact that no great diminution of mortality from deep seated lesions has been accomplished by the technique of the parallel spark length of eight to nine inches, filtration with two to six millimeters of aluminum, and crossfiring through a various number of portals.

The writer, therefore, attempted to approximate the German technique as he understood it, and as a result of this effort adopted the following technique, used with slight modifications according to the case:

Spark gap measured between blunt points 8½ to 9½ inches. *Milliamperes* 5. *Filtration* 0.5 mm. Cu under which is placed 1 mm. Al. *Skin-focus* 12 inches. *Time of exposure* 3 hours.

One to four areas have been treated with exposure time varying from three to twelve hours with not more than two hours daily treatment, and as a rule not more than one hour daily or on alternate days.

Roentgen sickness is as severe as with former methods. The effect on the skin varies from bronzing and desquamation to vesication, but healing has been complete within four weeks at the most. Difficulty in swallowing and huskiness result from treatment about the neck and upper thorax, but these subside. Pulmonary pneumonia has also resulted in some cases. Diarrhoea has sometimes occurred in uterine cases and in one case of cancer of the cecum uremia developed.

It is too early as yet to claim permanent cures. The technique above described has been used with seventy-five cases, all but eight of which were hopeless. Some of these have died and many of the others must inevitably die of cancer, but in many of the cases a complete disappearance of the local evidence has occurred, or is rapidly occurring, and the present status of these cases is very encouraging.

With regard to cancer of the breast the writers advise deferring operation for approximately two months and administering a single series of roentgen treatments with a "not less intensive" technique than the one described here. The advantages, they believe, are:

(1) The actual volume of cancer tissue would be greatly lessened and would in some cases disappear entirely, so far as could be determined by physical examination. (2) The danger of cancer dissemination incident to surgical trauma would be lessened. (3) A number of borderline cases would become definitely operable.

In the discussion following the reading of this paper Dr. Groover stated that he did not lay claim to having "the best" technique, as no one at the present knows what is the best.

The Possibilities of Irradiation in Malignant Disease. L. J. Clendinnen, M. B., M. J. Australia, April, 1922, p. 456.

THIS is a paper written for the information of the general practitioner, and takes up the subject of x-ray briefly in its various phases, from the

[illegible] to the latest technique. The author summarizes by saying that technique and equipment are passing through a rapid and important development and that the time is not yet ripe for radiation to supplant surgery, but that the success of radiation is assured and that the future has great possibilities, dependent to a large extent upon the friendly and intelligent co-operation of surgeon and radiologist.

Heliotherapy in Treatment of Laryngeal Tuberculosis. William C. Voorsanger, M. D., Am. Rev. Tuberculosis, 6:223, May, 1922.

Verba's apparatus, used in heliotherapy of laryngitis and laryngeal tuberculosis, reflects a higher percentage of ultra violet rays, absorbs many heat rays, and does away with the objections formerly arising from the hyperemia induced.

The patient is taught to manipulate the apparatus himself. The writer uses this form of therapy for all cases; even those far advanced are made comfortable by it. Of seven cases treated by the author, two are regarded as cured, three are still under observation and are improving, and two left the sanitorium improved, but before a definite result could be obtained. Complete arrest is possible in infiltration and mild ulcerative stages if the treatment is carried out for six months.

Actino Therapy in Infection. Arthur E. Schiller, M. D., J. Michigan M. Soc., 21:247, June, 1922.

THE writer has used the ultra violet rays in the treatment of abscesses, bone tuberculosis, tubercular glands, bone and joint infections, chronic leg ulcers, infected incision wounds following operations, infected injury wounds, indolent ulcers such as x-ray burns and chancroidal ulcers. If employed early enough they "will abort infection and prevent abscess formation." In the later stages they hasten suppuration, relieve pain and hasten repair. He summarizes thus:

"(1) Ultra violet light is an agent that should not be neglected in the treatment of infections. (2) It will stimulate the normal defensive power of the blood, sterilize tissues, produce active hyperemia, inhibit bacterial action and regenerate epithelium. (3) It is not a panacea, but must be used in conjunction with other surgical measures. (4) It will give quicker relief from pain and freedom from infection than any other agent. (5) It is fool proof and can be used on all parts of the body without danger."

Quartz Light Therapy in Pelvic Inflammation. L. C. Donnelly, M. D., J. Michigan M. Soc., 21:254, June, 1922.

ABOUT nine thousand treatments, a large number of which were given in gynecological cases, are here cited and are said to have produced marvelous results in some cases and benefit in all.

Mild pelvic inflammations can be cured without operation. General treatments are given with Alpine, sun, and radiant lamps, and local treatments with the Kromayer lamp. These latter often give relief immediately and they have a general tonic effect. The more acute the inflammatory condition the larger the dose and the less severe the reaction is the rule. Material benefit becomes increasingly apparent from week to week. Pre-operative treatment practically assures speedy healing.

It is regarded as proved that quartz light radiations produce additional leukocytes and hasten their maturity, thus building up the body's immunizing powers.

An Essay of the History of Electrotherapy and Diagnosis. Hector A. Colwell, M.B., L.R.C.P., M.R.C.S., D.P.H., Wm. Heinemann, 20 Bedford St., London, W. C. 2., England.

DR. COLWELL begins his essay with an account of the use of the torpedo, an elassnobranch fish of the ray family, as the first source of static electricity employed in the treatment of disease. He traces the history of medical electricity as it rises to the advantages accruing from royal and other distinguished patronage in the middle of the eighteenth century and then gradually declines on account of over exaggerated reports until 1831, when Faraday discovered electromagnetic induction, which ushered in a new era.

Some of the high lights touched upon are Holtz, in 1865, and his induction machine; Duchenne, 1840, the founder of modern electrotherapeutics; H. D. Ruhmkorff, 1803-1877; W. E. Steavenson, 1882-1890; Lewis Jones, 1890,1911; and Sir Wm. Crookes, 1832-1919, whose work rendered possible the discovery of the x-rays in 1895 and the later work of living scientists.

The book closes with a short account of the discovery of radium and a tribute to Becquerel, Schmidt, M. and Mme. Curie and others.

Wide use is made of interesting illustrations. There are one hundred and fifteen in all. These are widely diversified, including as they do photographs of the great and near great, living and dead; different examples of apparatus; and also a copy of "The New Photographic Discovery" taken from a modern "Punch." This last suggests the lighter vein that is not lacking in this truly accurate historical work, which shows a prodigous amount of careful research and detail work. The whole is written in a delightful and clear essay style and holds the reader's interest straight through its one hundred and ninety pages. It is attractive also in the very excellent quality of paper used and the easy reading print. It deals with the development of different forms of apparatus, perhaps somewhat, as the author says, to the exclusion of a connected view of the progress of electrotherapy itself. But this last is sketched in lightly in the concluding pages.

The dedication page reads simply, "Dedicated to Robert Knox, M. D." But that is enough to an English reader. For, as one ardent admirer of Dr. Knox said in speaking of some position of administration which Dr. Knox occupied, "Well, you know, Dr. Knox is back of everything."

Oral Roentgenology: A Roentgen Study of the Anatomy and Pathology of the Oral Cavity. By Kurt H. Thoma, D. M. D. Second Edition, Revised and Enlarged. Octavo 341 pp., 470 illustrations. Lea & Febiger, Philadelphia and New York, 1922. Cloth, $6.00.

THIS second edition of Thoma's well known "Oral Roentgenology" (1917) has been considerably amplified, the additional subject matter covering one hundred and twenty-nine more pages than were in the first edition, exclusive of fifty-nine new photos, diagrams and plates.

The author states in the preface that the text has been almost entirely rewritten and that the new terms adopted by the American Academy of Peridontology have been used in the section dealing with peridental diseases. Additions and one entire new section have been added, the theme of the latter being roentgen technique. This section, written for the student and beginner covers fifty pages written in the simple style which medical writers too often shun to the great detriment of force and clarity. The short discussion of roentgen examination of the teeth in dental and trigeminal neuralgia are also new.

Additions and changes have been made in the sections on interpretation, abnormal dentition, diseases of the hard tissues of the teeth, those of the dental pulp, peridontoclasia, diseases of the maxillary and mandibular bones and those diseases of the accessory sinuses of the nose.

All roentgen pictures have been reproduced in the negative as in the first edition and are excellently done.

The author's name is sufficient guarantee of the excellence of the work.

RENTEX

RIEBER STABILIZER

MODEL K-2

A stationary magnetic system which will maintain a *constant filament temperature* over any voltage fluctuation allowable in commercial supply lines.

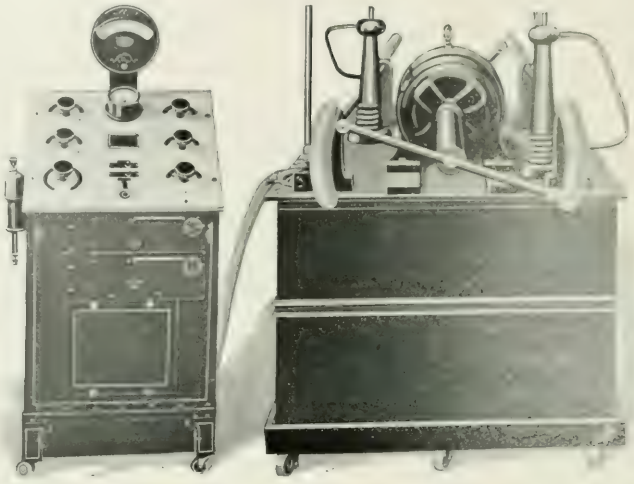
The only method which employs *no moving parts* or contacts to get out of order or stick.

The only method which operates all of the time—permitting *ultra-rapid exposures*.

ROENTGEN APPLIANCE COMPANY

SAN FRANCISCO CALIFORNIA

Kelley-Koett Deep Therapy Apparatus



Coronaless rectifying system as well as many other salient features.
Capacity 280,000 peak volts, equivalent to a 20 inch gap.

The only American apparatus with capacity sufficient for both double and single tube technique.

The Magnuson X-Ray Company

Denver
1510 Court Place

Omaha
1118 Farnam St.

Des Moines
561 Seventh St.

Kansas City
1006 Oak St.

The Engeln Electric Company

4601 Euclid Avenue, Cleveland, Ohio

Branches

New York, Philadelphia, Pittsburgh
Cincinnati, Toronto, Chicago
Detroit, Los Angeles, Portland Ore.

The Dick X-Ray Company

4221 Olive Street, St. Louis, Mo.

Branch Offices

Indianapolis, Indiana
Memphis, Tennessee
Louisville, Kentucky

Chandler and Fisher, Ltd.

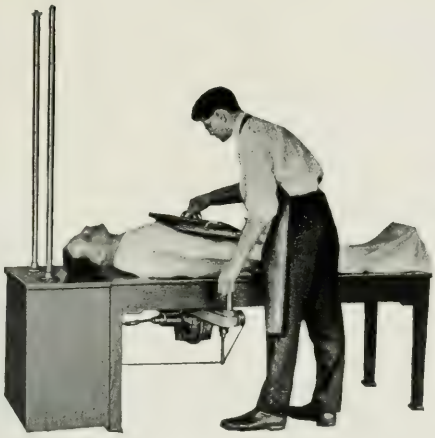
Winnipeg, Man.
Edmonton, Alta.
Vancouver, B. C.

K. & B. Electrical Equipment Co., Inc.

127 East 23rd St., New York City, N. Y.

Boston, Mass.
177 Newberry Street

Buffalo, N. Y.
19 Allen Street



At Last!

A GOOD horizontal fluoroscope at a reasonable price--handsome in appearance and with the electrical advantage of wooden table construction---high class shutter mechanism with brake locking against motion in either direction--large size lead glass shield accommodating either Universal or Radiator type tubes---high tension masts completely boxed in and incased in metal tubes grounded to each other.

Horizontal Fluoroscope complete—including shutter mechanism, high tension masts, lead glass shield and one set cord reels—f. o. b. Cincinnati	$250.00
Coolidge Tube—Universal or Radiator Type	125.00
12x16″ Lead Glass, protected, mounted, fluoroscopic Screen	75.00
Price, complete equipment, f. o. b. Cincinnati	$450.00

THE MODEL P DYNELECTRON

supplies a long felt need for a first class high frequency equipment—besides having the advantage of portability (68 pounds), it delivers as much power as the heavy stationary machines costing two and three times as much—and will stand continuous operation—24 hours a day—without injury or overheating. The current is extremely smooth—absolutely free from any faradic sensation.

DELIVERS—

Electro-coagulation—full power for all purposes—including coagulation of epitheliomas, etc.; Diathermy—up to 4,000 M. A.; Auto-Condensation—up to 1,200 M. A.; High Frequency current for vacuum and non-vacuum electrodes—more than the electrodes or your patient can stand; Three stage—air cooled tungsten spark gap; Two meters—1,000 and 4,000 M. A.—interchangeable; Five points of regulation—Foot switch connection—and a transformer, resonator and condensers that are free from overheating or burnouts.

Price, complete, less accessories, f. o. b. Cincinnati	$200.00
Price, complete set of accessories—including Coagulation Electrode Points and Discs—Diathermy Metal—one Condenser Electrode—Auto Condensation Pad, etc.	40.00
Foot Switch	7.50

THE LIEBEL-FLARSHEIM CO.

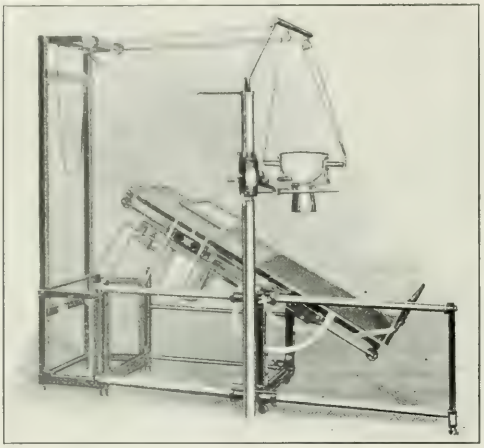
410-418 Home St., Cincinnati, Ohio.

The Meyer X-Ray Apparatus

The Meyer Multoscope complete with self-contained aerial and high tension switch, connects directly to the transformer.

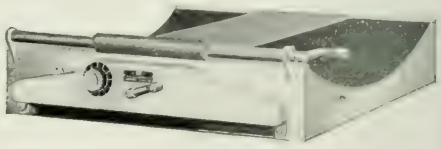
Fluoroscopy, Stereo-Radiography, Radio-Therapy

A most unique method of adjustment, no bother about position of overhead reels.



Meyer Bucky Diaphragm

All aluminum frame.
Extra fine regulation.
Adjustable at all times for standardizing.
Interlocking grid.
Twenty per cent greater speed than any other diaphragm now on the market.
Fine polished top.
Strap to hold patient.
Not surpassed, regardless of price.



The Winner in every competition

THE WM. MEYER COMPANY
1641½ No. Girard St. **Chicago, Ill.**

A COURSE in Physio Therapy covering a period of one year will be offered at Walter Reed General Hospital, Washington, D. C., beginning Oct. 2, 1922. Credit will be given for previous training in Physical Education, Nursing, Physiology and Anatomy so that the course may be completed in six months or even less. The schedule of subjects includes all branches of Physio Therapy and in addition, lectures in general hospital subjects.

Accepted candidates will be listed as student aides, and will be furnished quarters, rations, laundering of uniforms, and $15.00 per month. No tuition fees are required.

Graduates will be eligible for positions in the Physio Therapy Department of army hospitals, and are expected to serve one year. Graduate aides in army hospitals are provided quarters, rations, laundering of uniforms, and are paid a base salary of $60.00 per month, plus the Congressional Bonus of $20.00 per month.

Application blanks will be sent on request.

Address all communications to
K. F. Kresmodel, Major, U. S. Army,
Acting Director Physio Therapy

WANTED:-Chief Roentgenologist. Four hundred fifty bed hospital. Fully equipped X-Ray Laboratory, two technicians, two stenographers and a nurse. Salary to start $5,000.

Address:—X—R—33 Radiological Publishing Co., 305 Arthur Bldg., Omaha, Nebr.

P. H. KANTRO
Portage, Wis.

Highest prices paid for your old negative glass and portrait film, Write for prices and instructions before shipping.

WANTED:—Assistant to Chief Roentgenologist. Four hundred fifty bed hospital. Salary to start $2,000. to $2,500. Please state experience.

Address:—A—Y—34 Radiological Publishing Co., 305 Arthur Bldg., Omaha, Nebr.

The Citizen Printing Co.
PUBLICITORS

Omaha, Nebraska

We Print The Journal of Radiology

WANTED

X-ray salesman of experience, ambition and executive capacity. Write in detail, stating experience and territory worked. Application held in absolute confidence.

Address X-R-88, Radiological Publishing Company, 305 Arthur Bldg., Omaha, Nebr.

WANTED:-In middlewestern city of 160,000, an assistant to Radiologist in x-ray technique and therapy and radium therapy. State education, radiological experience, religion, age, references and salary expected. If services are satisfactory, a degree of partnership will be offered.

Address:--X—B--88 Radiological Publishing Co., 305 Arthur Bldg., Omaha, Nebr.

Post Graduate Medical School
OF CHICAGO
2400 S. Dearborn Street

Announces a complete course in

X-RAY WORK

Darkroom technique, physics, technique, therapy and diagnosis for physicians desiring to specialize in X-Ray.

Special attention given to training technicians for hospitals and institutions.

Complete course with practical work in all branches of X-RAY work.

Lectures in diagnosis illustrated with lantern slides, screen and plate interpretation with specially selected plates.

Large out patient clinic.

Students act as assistants in clinic.

A six months course is advised for those desiring complete training in fundamental principles. . Shorter courses can be taken if desired.

Special course in Diagnosis, two weeks.

All instruction under the supervision of

DR. B. C. CUSHWAY, D.D.S., M.D.

New classes are started on the first of each month

For particulars and for information on other courses for physicians and for Laboratory Technicians apply to

POST GRADUATE MEDICAL SCHOOL
2400 S. Dearborn Street, Chicago, Illinois

Applications for reservations should be placed as early as possible.

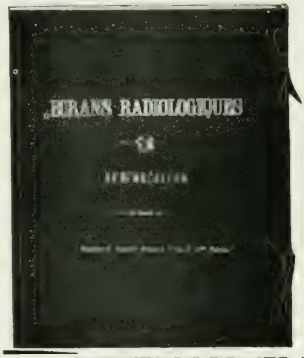
"Best By Test --- Regardless of Price"

FRENCH X-RAY INTENSIFYING SCREENS

This Screen is being exhibited at the various X-Ray Conventions with phenomena success. We are daily receiving letters from Roentgenologists who have purchased it expressing their pleasure and satisfaction, all of them sending re-orders,—*the best test of satisfaction.*

It is used and endorsed by the leading X-Ray men of this country. It is 25% *faster* than any other screen on the market today, is absolutely grainless, and possesses a range of detail (blacker blacks to whiter whites) unequalled, which makes the reading of your negative a pleasure! These advantages, together with the low prices at which we offer it, are worthy of your consideration. Ask for further information, and save 50% in your present high screen costs! The non-washable screen is furnished with our protective covering, which renders it immune to dust, spots and scratches, and prolongs its life indefinitely.

mediate deliveries, prices subject to 5% discount for check with the order,—or NET, payable upon receipt of screens. (Can be furnished with the Washable surface at 20% increase in prices, deliveries in one month.)



SIZE	SINGLE	DOUBLE
6½x8½	$10.00	$20.00
8x10	12.00	24.00
10x12	18.00	36.00
11x14	27.00	54.00
14x17	36.00	72.00

(Non-washable Screen, with our protective covering)
Every screen tested and guaranteed perfect.

FRENCH FLUOROSCOPIC SCREENS

We will be pleased to send circular describing a new Fluoroscopic Screen, the result of latest French research. This screen gives a pure white, concentrated light with minimum of power,combining the advantages of *distance* with *minimum of exposure* to the radiologist—two factors of great importance. Especially adapted for gastro-intestinal work with heavy patients where deep, rapid penetration is essential. Can be furnished n any desired size, at a big saving in cost.

SIZE	PRICE
11x14	$30.00
14x17	48.00

THE FRENCH SCREEN COMPANY

Sole U. S. Distributors of French Screens

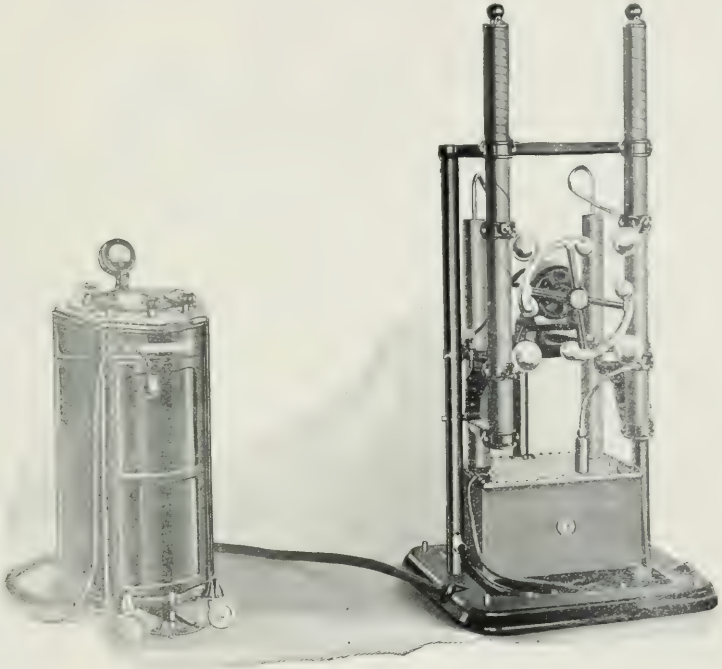
406 McKerchey Building—2631 Woodward Ave.

DETROIT, MICH.

ACME

Corona Proof Roentgen Generator

120 K. V. Crest Value—Equivalent to 7½ inch Point Gap (approximate)



SPECIAL FEATURES

Coronaless Rectification — *Point Gap or Magnetic Sphere Gap*

Complete with or without Cabinet

100 M.A. at 6 inch backup (100 K. V. Crest)

Especially designed for all classes of Radiographic and Fluoroscopic work

All Metal Frame — *Self Contained Filament Equipment*

Detailed information furnished upon request

MANUFACTURED BY

ACME X-RAY CO.

341-351 West Chicago Avenue — Chicago, Illinois, U. S. A.

Distributors in All Principal Cities

Announcing

5 Gallon size package
Chrome-Alum Fixing
and Hardening Bath $2.10

QUALITY CHEMICALS

Another convenient, economical and practical addition to the X-Ograph Chemical line.

BUCK X-OGRAPH CO.
ST. LOUIS, MO.

THE
PATTERSON CLEANABLE
INTENSIFYING SCREEN

SPEED

WHEN THE "PATTERSON CLEANABLE" INTENSIFYING SCREEN WAS INTRODUCED IN SEPTEMBER, 1921, THE SPEED WAS NOT UP TO THAT OF THE UNPROTECTED SCREENS.

UNDER DATE OF APRIL 1, 1922, IT GAVE US PLEASURE TO ANNOUNCE THAT, AS A RESULT OF CONTINUED RESEARCH AND EXPERIMENTAL WORK, WE WERE ABLE TO INCREASE THE SPEED OF THIS SCREEN SO THAT ITS SPEED IS ON A PAR WITH THE UNPROTECTED SCREENS.

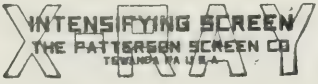
THEREFORE—THE "PATTERSON CLEANABLE" OFFERS

SPEED QUALITY SERVICE

THERE IS NO WORD MORE FREQUENTLY USED IN BUSINESS THAN

SERVICE

THE "PATTERSON CLEANABLE" IS REALLY MORE THAN THE WORD IMPLIES, FOR, IT IS PRACTICALLY IMPERVIOUS TO DIRT, DUST, PENCIL MARKS AND OTHER THINGS THAT CAN NOT BE AVOIDED BUT CAN BE GUARDED AGAINST. YOUR DEALER WILL TELL YOU THAT THE "PATTERSON CLEANABLE" INTENSIFYING SCREEN IS A REAL SCREEN AND WILL SOLVE YOUR PROBLEMS—BOTH SERVICE AND QUALITY.



THE SIGN OF QUALITY

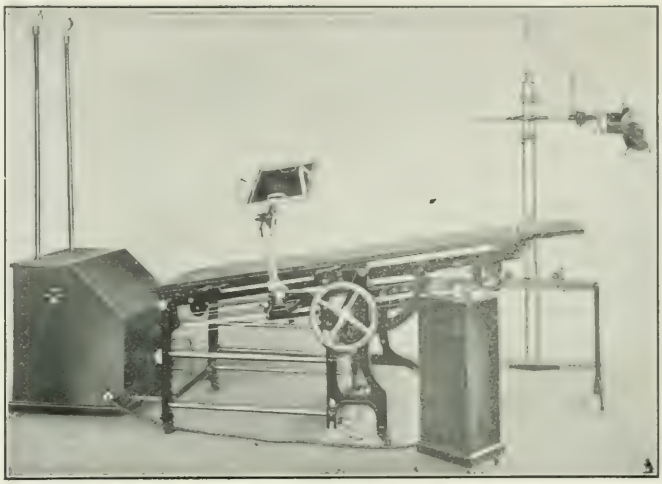
THE PATTERSON SCREEN COMPANY

TOWANDA, PENNSYLVANIA, U. S. A.

WAPPLER

WAPPLER NUMBER SIX

COMPOSITE X-RAY UNIT



Stereoscopic Radiography and Fluoroscopy
IN THE
Horizontal, Vertical, Trendelenberg and Intermediate Positions

(A COMPLETE PLANT INCLUDES X-RAY TRANSFORMER AND CONTROL UNIT)

The Composite X-Ray Unit is so standardized in construction that an initial purchase of a *plain tilt table* can be made for as little as $450.00 and the Unit made gradually complete,—by further purchases—so that—eventually the composite Unit—as shown above, is assembled.

An "Integral" Unit of the complete Composite Unit can be purchased so that any one of the functions described immediately above can be provided for, separately, without the necessity of purchasing the complete outfit.

It is the *lowest priced* unit of its kind now on the market—and in addition, is backed and guaranteed by WAPPLER with a record of "Twenty-five Years of Satisfied Users."

A complete description of the above development together with photographs illustrating it, will be sent upon your request. Please ask for P. C. D. No. 1.

WAPPLER ELECTRIC COMPANY, Inc.

General Offices and Factory
Long Island City, New York, U. S. A.

Show Rooms
173 East 87th St., New York City

WAPPLER

Two Per Cent Radium Insurance

It gives us pleasure to announce to physicians interested in radium that the Insurance Company of North America will write radium insurance at two per cent a year. For a loss under this policy the insurance company is liable for 75%.

When the great advances in radium insurance rates went into effect, we immediately took steps to obtain for physicians an acceptable policy at a reasonable premium. This announcement is the result.

Many owners of radium have been consulted regarding the policy which the Insurance Company of North America will issue and all have expressed approval of it. The policy is a liberal one. It contains no limiting clauses regarding the use of the element or the manner in which it shall be guarded while in use. We believe it will prove to be of value to you.

United States Radium Corporation

58 Pine Street New York City

Factories: Orange, N. J. Mines: Colorado

Dr. H. Threlkeld-Edwards
South Bethlehem, Pa.

THE SAME T-E SCREEN AT A NEW T-E PRICE

SIZE	STANDARD SCREEN	THIN TYPE SCREEN	STANDARD CASSETTE	UNIT
5 x 7	7.00	6.00	10.00	23.00
6½ x 8½	10.00	8.00	10.00	28.00
8 x 10	16.00	15.00	12.00	43.00
10 x 12	25.00	22.50	15.00	62.50
11 x 14	32.00	30.00	17.00	79.00
14 x 17	50.00	45.00	20.00	115.00

ASK YOUR DEALER

SPECIAL
X-RAY COURSE

Our six weeks special course for technicians is under the supervision of one of the leading Roentgenologists of the country, and as we limit the size of our classes, each matriculant receives personal instruction.

We have recently added one of the most complete and latest type Kelley-Koett Transformers and Motor Driven Tables to our already well equipped laboratory.

The tremendous stride that has been made in recent years, as well as the fact that the physicians realize, perhaps for the first time, the necessity for accurate and complete diagnosis, **has created an acute demand for well trained technicians, as indicated by our long list of openings for graduate technicians, from physicians and laboratories throughout the country.**

Realizing that every matriculant desires to get the most in the shortest possible time, to fit him or her as a competent assistant, we have recently added this **special course of intensified training**

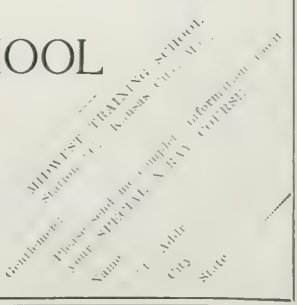
This course is open to laymen as well as physicians.

MIDWEST TRAINING SCHOOL

An ethical institution established by physicians

Station "C" KANSAS CITY, MO.

Mail coupon today



INTENSIFYING X-RAY SCREENS

Equal to any intensifying screen for plate or film work on the market.

Your money refunded if not entirely satisfactory or as represented.

SIZE	SINGLE		DOUBLE	
	WASHABLE	CLEANABLE	WASHABLE	CLEANABLE
8 x 10	$ 8.00	$ 7.50	$16.00	$15.00
10 x 12	11.00	10·00	22.00	20.00
11 x 14	16.00	15.00	32.00	30.00
14 x 17	22.00	20.00	44.00	40.00

CASSETTES

TERMS—C. O. D.	8 x 10	$13.50
	10 x 12	14.75
	11 x 14	15.50
	14 x 17	16.50

NATIONAL X-RAY SCREEN CO.

1308-24 North Wabash Ave. Chicago, Ill.

FOR ALL RADIOGRAPHIC and FLUOROSCOPIC WORK

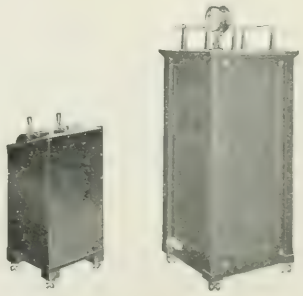
THE STANDARD X-Ray Transformer, "Type D," is ideal for the office o the general practitioner. With it all radiographic and fluoroscopic work may be done efficiently, accurately. and as speedily as desired.

Furnished with remote control—at a price which will prove interesting to those who desire convenience, power and compactness in their X-Ray equipment.

67½ kilo-volt capacity (any line voltage)

STANDARD X-RAY COMPANY

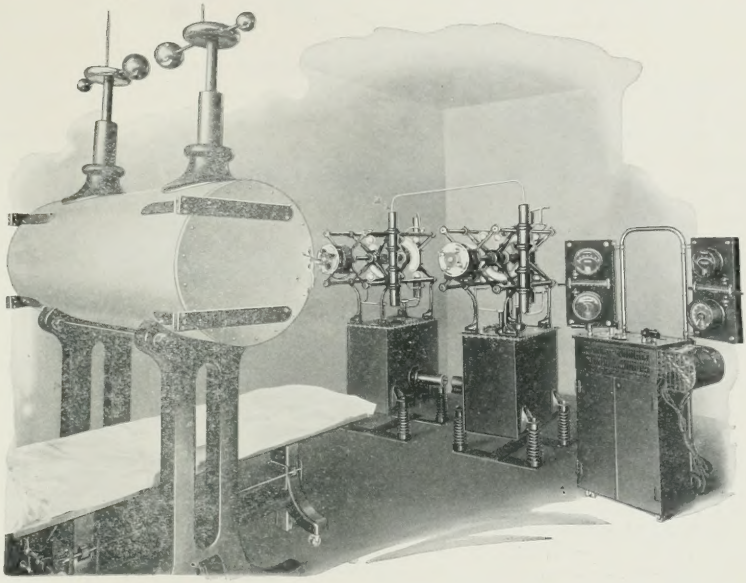
1932 North Burling Street - - - - - Chicago



INTERNATIONAL

A Mark Of Quality *A Sign Of Service*

DEEP THERAPY TYPE X-RAY APPARATUS



ECONOMY IN INVESTMENT—ACCURACY IN RESULTS

SAFETY IN OPERATION

The machine featuring constant form of rectification by use of the sphere gap characteristics; the Crest Kilovolt Meter for reading the actual secondary potential; all meters at ground potential and Westinghouse equipment.

Write for illustrations and Brochure No. 5

INTERNATIONAL X-RAY CORPORATION

326 BROADWAY NEW YORK CITY

Sales Distributors conveniently located and capable of rendering the best service

CLEAN SCREENS

- T-E Screens
- Patterson Screens
- Duplitized Films
- Seed or Diag. Plates
- Dental Accessories
- Buck X-Ograph
- Electro Cardiograph
- Film Mounts
- Plate Accessories
- Pl. Chang. Tunnels
- Fluoroscopic Screens
- Photographic Papers

It is most important that every care be taken of the intensifying screen. Any damage to the delicate surface, scratches or other markings causing an abrasion will be reproduced on the negatives.

The duration of your screens depends upon the care you give them. Continued exposures to x-rays will never destroy their efficiency.

It is necessary to have good contact in order to obtain sharp details. Therefore, have your screens properly mounted in cassettes.

The mounting of screens into cassettes is part of the Picker Service. Send your screens to us and we will mount them promptly and carefully.

- Dark Room Access.
- Tanks
- Trays
- Film Dev. Hangers
- Plate Dev. Racks
- Red. & Print. Acc.
- Tubes
- Tube Racks
- Barium Sulphate
- Chemicals
- Developer
- Fixing Powders

X-Ray James Picker Accessories

JAMES PICKER, Inc.

686-688 Lexington Avenue

New York, N. Y.

SOUTHERN BRANCH, Inc., 609 Common St., New Orleans, La.

What would it mean to you

To have an Intensifying Screen that was perfectly waterproofed without in any degree depriving it of its speed?

To have an Intensifying Screen with the perfect grainlessness of the Sweetbriar Screen, and yet extremely fast?

The new Sweetbriar Screen will give you just these qualities.

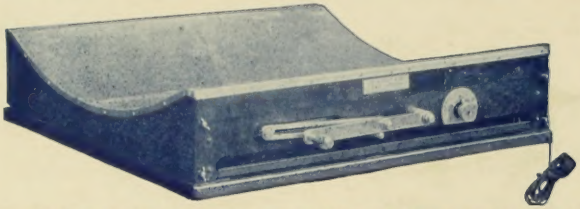
It is surprisingly fast, while the radiographs made with it show a sharpness of outline and wealth of detail produced by no other screen.

It is waterproofed by the new Sweetbriar process, which does not decrease its speed at all.

Until you have tried the NEW SWEETBRIAR SCREEN, you do not know how good radiographs can be.

SWEETBRIAR LABORATORIES, Inc.
1220-1228 Hodgkiss St., N. S.
Pittsburgh, Pa.

BRADY'S POTTER BUCKY DIAPHRAGM



For Finest Radiographic Work

We placed the first Bucky diaphragm on the market months ahead of other firms. Some of the first twelve are still in use by prominent roentgenologists. The many hundreds of satisfied users are our best "ads."

Now, after eighteen months, we have perfected a new grid that will give even finer detail than the original type. We are using the same type speed control as it has proven absolutely reliable and accurate.

We claim to have the smallest, neatest and most accurate Potter Bucky on the market. Electrically welded frame and base, with metal construction, make it practically indestructible. Takes all makes of cassettes up to 17x17. Operates in horizontal or vertical position. Exposure range from 1 to 9) seconds. Distance from 16 to 40 inches. Does stereoscopic work in either direction. Electric light signal device indicating when grid is moving, free if desired.

We absolutely guarantee radiographs free from the "Corduroy" lines, due to defective mechanism in some other makes.

YOU CANNOT GET A BETTER BUCKY AT ANY PRICE AND NO X-RAY LABORATORY IS COMPLETE WITHOUT ONE

Price $250.00 list, less 10% for cash within ten days, or $225.00 net.

X-RAY INTENSIFYING SCREENS

SWEETBRIAR SCREENS — Excellent quality throughout. They are guaranteed to be FREE FROM GRAIN. FAST. CLEANABLE, WITHOUT SACRIFICING SPEED, RELIABLE. Result—BRILLIANT RADIOGRAPHS. To introduce SWEETBRIARS we are offering a special discount of 20% from list price for cash in ten days.

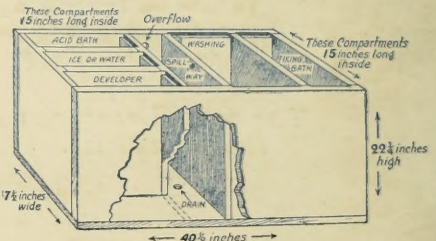
PATTERSON SCREENS — There has been a change in price on Patterson Screens. We can now offer the single Pattersons in both REGULAR and CLEANABLE at one-half the Combination List. Discount 10% for cash in ten days.

PARAGON SCREENS — A very fine product in every way. We do not hesitate recommending the PARAGONS for all ORDINARY RADIOGRAPHIC work. The price is especially low, being APPROXIMATELY ONE-HALF that of other standard makes. Cash discount from this low list, 5% for payment in ten days.

ALL SCREENS ARE SOLD SINGLY OR IN PAIRS, or we will mount them in YOUR OWN, or in NEW CASSETTES, if so desired. We will allow a discount of 20% from list on CASSETTES WHEN ORDERED WITH SCREENS.

STONE DEVELOPING TANKS

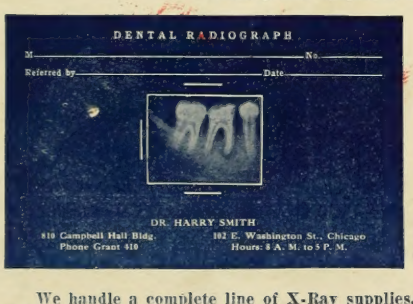
At this season a good tank is a valuable asset as warm wash water may heat the developer fogging the plates, and tending to melt off the gelatin. The 6 compartment tank has a special space for hardening solution that absolutely prevents hot weather troubles, and is considered the best designed tank made. All of our tanks have a chamber next to the developer for ice or hot water, for maintaining the developer at the proper temperature. The 5 and 6 compartment tanks also have a 4 inch air space next the washing chamber. The 5 compartment tank is a new one for general laboratory use. For hospitals or specialists we recommend the 6 compartment tank.



	4-Comp.	5-Comp.	6-Comp.
F. O. B. Chicago or Brooklyn	$45.00	$52.00	$58.50
F. O. B. Virginia	40.00	49.00	55.00

ENAMEL TANKS—3-compartment style, 8x10, $22.50—11x14 size, $27.00.

These prices subject to a 10% discount for cash in ten days.


DENTAL RADIOGRAPH
M. No.
Referred by Date
DR. HARRY SMITH
810 Campbell Hall Bldg. Phone Grant 410
102 E. Washington St., Chicago Hours: 8 A. M. to 5 P. M.

DENTAL MOUNTS AND FILMS

We have many types of film mounts, including the green, gray and black cardboard with a celluloid window and all-celluloid mounts. We are offering same at lower prices and liberal discounts. Our new "SUNNYSIDE" MOUNT is guaranteed to remain flat. We also have a new cardboard mount without celluloid to hold the new Eastman Translucent Film with frosted back.

DUPLITIZED FILMS — DENTAL FILMS
BARIUM SULPHATE — FILING ENVELOPES
COOLIDGE TUBES — X-RAY PLATES
G. E. PORTABLE OUTFIT

We handle a complete line of X-Ray supplies. We can promise quick shipments of reliable merchandise at low prices and liberal discounts. Get our quotation before you place your order elsewhere. Don't throw away good money. Before you invest—investigate.

GEO. W. BRADY & CO. 802 S. Western Ave., Chicago

Southern Office, 10 Tulane Crescent Arcade, New Orleans